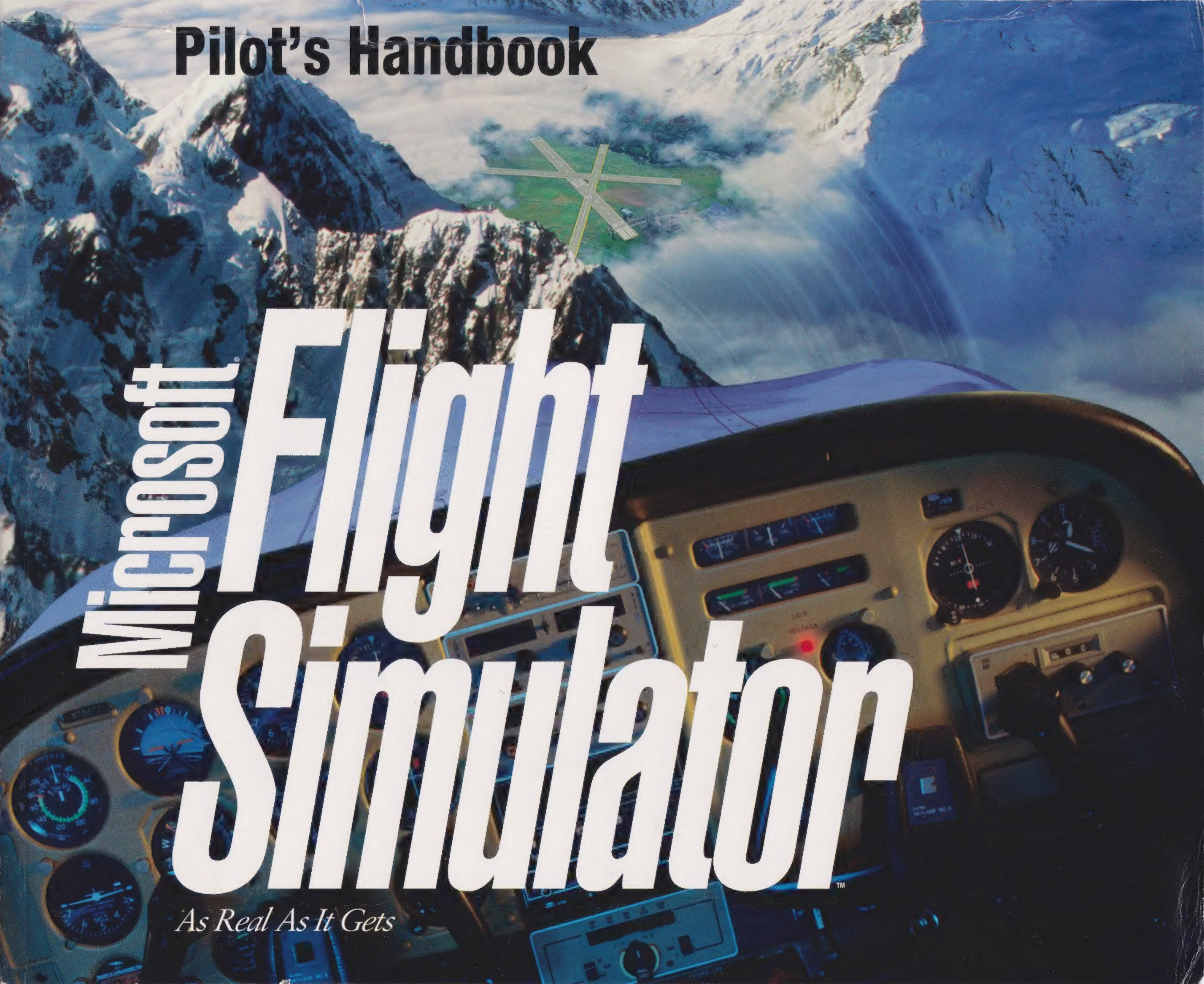
Pilot's Handbook

Microsoft® Flight Simulator™

As Real As It Gets



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- The version number of the DOS operating system you are using
- The type of hardware you are using
- The exact wording of any messages that appeared on your screen
- What happened and what you were doing when the problem occurred
- How you tried to solve the problem

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Pilot's Handbook

Version 5.0
For MS-DOS® Systems

Microsoft® Flight Simulator™

As Real As It Gets

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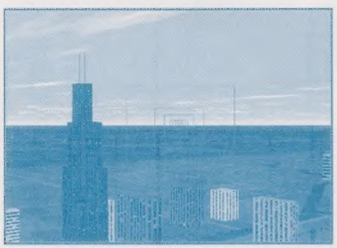


Getting the Most from Flight Simulator 169

Welcome

Welcome to Microsoft® Flight Simulator™, a fifth-generation, real-time flight-simulation program designed for pilots of all ages and levels of experience. The simulation incorporates important aircraft characteristics and transforms your computer screen so that you can instantly experience the feeling of flying. Flight Simulator includes a three-dimensional cockpit flight display, extensive flight controls, and minimum visual flight rule (VFR) and instrument flight rule (IFR) instrumentation as specified by the Federal Aviation Administration (FAA).

Take a look at what's new in Flight Simulator version 5.0!

Graphics Flight Simulator features detailed graphics that closely simulate a pilot's actual perspective. The sky reflects the gradient colors of the horizon, while photo-realism adds depth to your instrument panel and makes the airport shimmer below as you descend for a landing. You can also watch other aircraft take off and land around you as service trucks dodge traffic on the runways.

Flight Simulator's world Flight Simulator's world encompasses the entire real world, with accurate latitude and longitude coordinates. You can begin or resume flight at the airport or at the exact coordinates you want, or you can fly a variety of interesting prerecorded flight situations and even record your own flight videos for playback at a later time.

If you need a definition or explanation of a term, check the Glossary on page 251.

In-flight realism In Flight Simulator, you can change environmental conditions such as time of day, season, wind, clouds, and turbulence. As you become a more experienced pilot, you can also set realism and reliability factors to determine how frequently flight problems arise, and you can test your skills by dealing with malfunctioning equipment in the air.

Flight instruction Flight Simulator provides flying lessons at varying degrees of difficulty. If you have never flown before, you can use the basic lessons and the simplest controls to learn the fundamentals of flight. When you have mastered the basics, or if you are already a seasoned pilot, you can choose more realistic and complicated controls to simulate advanced flight maneuvers. If you dare to go one step further, you can try the aerobatics course.

For more information on how to take off and land right away, see "Flying Start" on page 14.

Flying Start If you want to take your plane up right away and don't have the time for flight school, it's easy. Start by taking off, and pick up some of the fundamentals of flying while you're at it. Believe it or not, you can also land safely on your first flight! If you are flying the Cessna, Flight Simulator now offers the Land Me option so that you can achieve immediate success with one of the more difficult early learning hurdles.

Flight Simulator's aircraft Flight Simulator simulates a single-engine, high-performance, propeller-driven Cessna Skylane RG; a Learjet 35A; a Schweizer 2-32 sailplane; and a Sopwith Camel.

The Cessna 182-type, single-engine prop aircraft is an ideal plane for pilot training because it has the performance and speed that keep a pilot busy, especially on the landing approach. This aircraft's simulation is designed for realism, both in what you see and how you feel behind the controls.

The Learjet simulation is designed for fun and accuracy. The aircraft is fast, aerobatic, and powerful. You can cruise at a speed of 460 knots at an altitude of 41,000 feet.

The sailplane simulation offers both the thrill of soaring using thermals and ridge lift, and a more graceful and gentle flight experience.

The Sopwith Camel is a simple bi-wing aircraft with controls similar to those of the Cessna.

Entertainment Flight Simulator offers fun flying with your friends in dual-player flight. It also includes a crop-dusting game, as well as formation flying and Electronic Flight Instrument Systems (EFIS) scenarios to test your skills.

About the Designers

Flight Simulator was created by Bruce Artwick of The Bruce Artwick Organization, Ltd. (BAO), a group that specializes in computer-simulation design. Artwick gained extensive experience in high-performance signal processor architecture and radar control systems at Hughes Aircraft Company and has researched microcomputer-based graphics system design at the Aviation Research Laboratory and Digital Computer Laboratories, University of Illinois, where he received a B.S. and an M.S. in electrical engineering. BAO consists of a group of engineers who share an interest in aviation and computer-graphics simulation, and who have pilot ratings ranging from private to instrument flight instructor.

About the Pilot's Handbook

The *Microsoft Flight Simulator Pilot's Handbook* includes all the instructions you'll need to fly Flight Simulator. The book is divided into nine parts, as shown in the following table.

Go to	For information on
"Welcome"	The many features that Flight Simulator offers
	The developers of Flight Simulator
	How the *Pilot's Handbook* is organized and presented
"Flight Simulator Basics"	System requirements
	Installing and starting Flight Simulator
	Using menus and commands
	Setting up special features before you fly
"Flying Flight Simulator"	Taking off and landing right away
	Flying each of the Flight Simulator aircraft: Cessna Skylane RG or Sopwith Camel, Learjet, Sailplane
"In and Out of the Cockpit"	Using the instruments and aircraft controls
	Scanning the horizon from the cockpit
	Viewing your aircraft from a spot plane or from the control tower
"Flight Simulator's World"	Changing your airport, exact location, or scenery area
	Changing the time, season, and weather
"Flight School"	Basic, advanced, and aerobatic flight instruction
	Navigation instruments and how to use them
	Flight analysis and instant replay
	Using a logbook
"Entertainment"	Dual-Player flight
	Formation Flying and Crop Duster games
	EFIS navigational challenges

Go to	For information on
"Getting the Most from Flight Simulator"	Special Flight Simulator features
	Advanced scenarios to test your flying skills
	Books to further your knowledge of flying
	Common questions and answers about Flight Simulator
"Appendixes"	How to get the most from the mouse, keyboard, and joystick
	Sectionals, directories, and runway maps
	Aircraft performance specifications
	Keyboard summary
	Accessibility for people with disabilities

Following the appendixes is a glossary that offers definitions of aircraft controls and flight-related terminology.

At the end of the book there is a comprehensive index. If you can't find what you want in the table of contents, look it up under the word or phrase you are most familiar with, and go straight to the topic that you need.

You'll find a handy Quick Reference on the back cover.

Conventions

Familiarizing yourself with the following conventions will help you use Flight Simulator.

- Generic terminology is used for most actions that you perform with either the mouse or the keyboard. For example, "Choose the OK button" means click the OK button or press ENTER.

For more information on menus and commands, see "Exploring Menus and Commands" on page 5.

- You can use both the mouse and keyboard to choose menus, commands, and dialog box options. With the mouse, simply point and click the *left* button. Menus, dialog boxes, and alerts follow industry standards. If you choose a command name or option that is followed by an ellipsis (...), Flight Simulator displays a dialog box where you make additional choices. Keyboard shortcuts are displayed beside command names on the menu.

For more information on flying with the keyboard, see Appendix D, "Keyboard Summary," on page 239

For more information on Pointer and Yoke modes, see "Using the Mouse" on page 203.

- A plus sign between two keys means that you press and release the two keys at the same time. For example, "To quit Flight Simulator, press CTRL+C" means that you hold down the CTRL key while pressing the C key.
- You can use both the mouse and keyboard for flight-control functions. With the mouse, simply click the *right* mouse button and your mouse becomes the aircraft control yoke. The mouse pointer disappears from your screen and you fly by dragging the mouse left, right, up, or down. With the keyboard, you can find all the keys you need for aileron, rudder, and elevator controls, as well as view directions, on the numeric keypad. Keys on the numeric keypad include the LEFT ARROW, RIGHT ARROW, UP ARROW, and DOWN ARROW keys, or other numeric keypad keys specified as such—for example, KEYPAD 5.
- Some instruments and controls on the instrument panel have letters on them. These letters tell you which keys to press. For example, the "G" on the right side of the gear indicator reminds you that you press G to lower and raise the landing gear. With the mouse, just click the gear indicator.
- You use the PLUS SIGN and MINUS SIGN keys to increase and decrease the setting of many instruments. Always press the key for the instrument you want before you press the PLUS SIGN or MINUS SIGN key. For example, press C for the COM radio, and then press the PLUS SIGN or MINUS SIGN key to raise or lower the frequency. With the mouse, just click the digits on the instrument panel to change settings.
- The side columns throughout the book contain tips, notes, illustrations, and cross-references to other information that will further your knowledge of flying.
- The Glossary on page 251 provides definitions and explanations of aeronautical terms, instruments, and commonly used flying expressions.

Flight Simulator Basics

This section covers the fundamentals of Microsoft Flight Simulator. It will get you up and running in Flight Simulator and help familiarize you with the organization of the program. If you understand the basics, you'll get the most out of flying.

Chapter 1, "Installing and Starting Flight Simulator," is a step-by-step guide that shows you how to set up and start Flight Simulator.

Chapter 2, "Exploring Menus and Commands," gives you an overview of the menu and command structure in Flight Simulator. It also describes in detail the Preferences command on the Options menu, and explains the importance of setting preferences before you begin to fly.

Chapter 1 Installing and Starting Flight Simulator

It takes only a few minutes to get ready to fly. The Setup program in Microsoft Flight Simulator makes installation easy. In case you want a quick review of the system requirements, we've listed them first.

System Requirements

For information on how to get the most from your system and enhance the Flight Simulator experience, see "Memory" and "Performance" on pages 194-196.

If you are using a VGA or EGA card, you can see additional instruments on the Cessna instrument panel by pressing the TAB key.

The recommended system requirements for Flight Simulator are:

- Industry Standard Architecture (ISA) such as IBM® PC and compatible; Micro Channel Architecture (MCA) such as IBM PS/2® and compatible; or Extended Industry Standard Architecture (EISA) 80386, 80486, or Pentium computer.
- MS-DOS® or PC-DOS (version 3.2 or later).
- Hard drive with 14 megabytes (MB) of free disk space.
- 530 kilobytes (K) conventional memory and 2 MB free memory configured as expanded (EMS) with appropriate memory driver to use all Flight Simulator features, including sound. Minimum total memory requirement is 1 MB (largest executable program size is 530K).
- 3.5-inch high-density disk drive.
- Video Graphics Array (VGA) or Super Video Graphics Array (SVGA)—an Enhanced Graphics Adapter (EGA with 256K) is the minimum requirement.

For information on sound for Flight Simulator, see "Sound" on page 198.

Optional:

- Sound card
- Microsoft Mouse or other compatible pointing device
- One or two joysticks or a control yoke connected to an IBM-compatible game control adapter

Installing Flight Simulator on Your Hard Disk

Your first step to flying Flight Simulator is to install it on your hard disk.

For tips on troubleshooting during Setup, see the "Troubleshooting Guide for Setup" on the inside of the back cover.

On some computers, Setup takes between 15 and 30 minutes. This is a great opportunity to look through the Microsoft Flight Simulator Pilot's Handbook and get a jump start on flying skills.

You can only install add-on programs that are compatible with Flight Simulator version 5.0 or later.

To install Flight Simulator

1. Make sure your computer and monitor are turned on.
2. Insert Microsoft Flight Simulator Disk 1 - Setup in drive A or drive B, and close the drive door, if necessary.
3. Change to the drive where you inserted Disk 1.

   For example, if Disk 1 is in drive A, type **a:** and then press ENTER.
4. Type **setup** and then press ENTER.

   Flight Simulator displays the Setup dialog box.
5. Follow the instructions on the Setup screens to install Flight Simulator.

   To cancel installation at any time, press the ESC key or choose the Cancel button.
6. When the installation is complete, you'll have three options to choose from:
   - If you want to start flying right away, choose the Run Microsoft Flight Simulator button.
   - If you own an add-on program, such as Aircraft & Scenery Designer version 5.0 or later, and want to install it now, choose the Install Add-On button.
   - If you want to exit to MS-DOS and return to Flight Simulator later, choose the Exit To MS-DOS button.

Starting Flight Simulator

If you use Microsoft Windows™, you can create a program item for Flight Simulator so that you can start it from Program Manager. For more information on how to create a program item, see "Setup" on page 193.

On slower computers, you may experience a delay before Flight Simulator starts.

Here's how to start Flight Simulator from MS-DOS at any time.

To start Flight Simulator

1. Make sure your computer and monitor are turned on.
2. Change to your Flight Simulator directory.

   For example, to change to the directory on your hard disk called FLTSIM5, type **cd fltsim5** and press ENTER.
3. Type **fs5**
4. Press ENTER to start Flight Simulator.

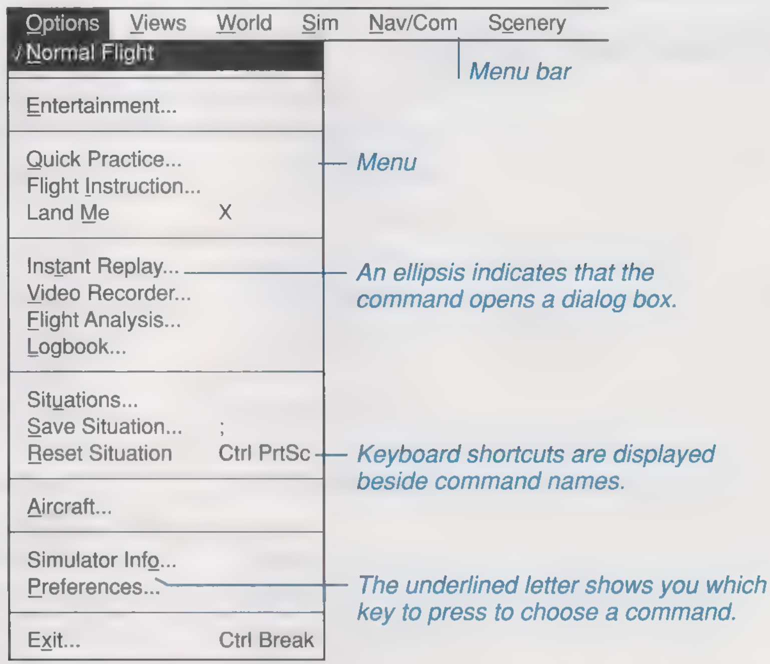
Congratulations! You are now on runway 36 at Meigs Field in Chicago. If you want to experience the thrill of taking off and landing right away, turn to "Flying Start" on page 14.

Chapter 2 Exploring Menus and Commands

The menu bar across the top of the Flight Simulator window displays the names of the menus you use to control the simulation. Each menu lists the commands you need to operate your aircraft and specify flight conditions.

Choosing a Command

To choose a command with either the mouse or the keyboard, you open a menu and then choose the command you want. The following illustration shows Flight Simulator with the Options menu open.



A pointer on the screen indicates that you are in Pointer mode and you can click the left mouse button to choose menus and commands. For more information on Pointer and Yoke modes, see "Using the Mouse" on page 203.

If there is a key name, letter, or symbol beside the command name, keyboard users can use this as a shortcut key.

To choose a command with the mouse

- ▶ With the mouse pointer, click the name of the menu you want to open, and then click the command you want.

  Click anywhere outside a menu to close it.

To choose a command with the keyboard

- ▶ Press ALT+ the underlined letter of the menu you want to open, and then press the underlined letter of the command you want.

  Press ESC to close a menu.

Menu and Command Summary

The following table offers Flight Simulator's menu and command structure at a glance, with a brief description of each command.

Menu/Command	Summary
Options	
Normal Flight	Fly through the Flight Simulator world.
Entertainment	Practice flying skills with fun and games.
Quick Practice	Familiarize yourself with a first flight and practice landing.
Flight Instruction	Take basic, advanced, and aerobatic flying lessons.
Land Me	Land the Cessna safely on early flights with guidance from the control tower.
Instant Replay	Replay and review your flights.
Video Recorder	Watch and create your own flight videos.
Flight Analysis	Analyze a post-flight graph.
Logbook	Create, edit, review, and delete logbooks.
Situations	Fly a variety of prerecorded situations.

For more information on Preferences and how to change them, see "Changing Preferences" on page 8.

Menu/Command	Summary
Options, cont'd	
Save Situation	Save your own situations.
Reset Situation	Start a situation over.
Aircraft	Fly the Cessna, Learjet, Sailplane, or Sopwith Camel.
Simulator Info	Check simulator and system information.
Preferences	Change preferences.
Exit	Quit Flight Simulator.
Views	
View 1	Turn View 1 on or off.
View 2	Turn View 2 on or off.
Map View	Turn Map View on or off.
Instrument Panels	Turn the instrument panel on or off.
Instrument Panel Options	Switch to other instrument panels; cover or impair instruments.
Mini Controls	Watch the miniature control panel while you fly.
Set Spot Plane	Set the distance and altitude of the spot plane.
View Options	Change view perspectives and view directions.
Maximize Window	Enlarge the active window.
Size And Move Windows	Size and move the active window.
Flight Photograph	Take in-flight photographs.
World	
Slew	Change your location by slewing.
Airports	Choose your airport of departure.
Set Exact Location	Set your exact latitude and longitude.
Set Time And Season	Set the time of day and season.
Weather	Choose weather conditions.

Menu/Command	Summary
Sim	
Sound	Turn sound on and off.
Pause	Pause the simulation.
Crash Detection	Choose crash detection and analysis.
Simulation Speed	Change the speed of the simulation.
Auto Coordination	Turn auto coordination on and off.
Smoke System	Turn the smoke system on and off.
Realism And Reliability	Set realism and reliability factors.
Engine And Fuel	Check your engine and fuel.
Calibrate Altimeter	Calibrate your altimeter.
Nav/Com	
Autopilot	Set the autopilot.
Air Traffic Control	Set air traffic control communication.
EFIS/CFPD Display	Fly with the electronic flight instrument system.
Communication Radio	Set the COM radio.
Navigation Radios	Set NAV 1 and NAV 2 radios.
Transponder	Set the transponder.
ADF	Set the automatic direction finder.
Scenery	
Scenery Library	Choose scenery areas.
Scenery Complexity	Vary scenery density.
Dynamic Scenery	Choose moving scenery options.

Changing Preferences

For information on how to get the most from your system and enhance the Flight Simulator experience, see "Memory" and "Performance" on pages 194-196.

When you install Flight Simulator, the Setup program determines your system configuration and helps you to make decisions about which options to turn on at startup. Flight Simulator keeps these initial preferences as uncomplicated as possible so that beginning pilots can get off the ground and quickly and easily stay airborne.

As you learn more about flying and the display and sound characteristics of your computer, you can change the initial startup preferences.

If you make changes to certain Preferences (such as Graphics Mode under Display Preferences or Sound Board under Sound Preferences), Flight Simulator prompts you to restart your computer so that these changes take effect.

To change preferences

1. From the Options menu, choose Preferences.

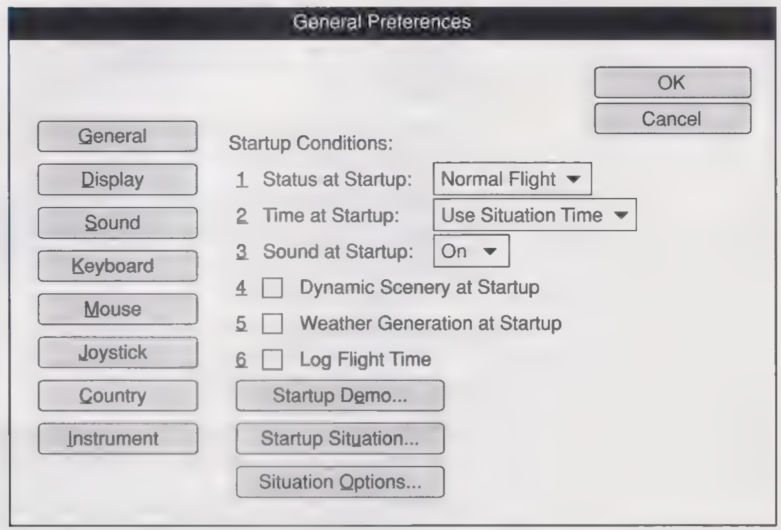
   Flight Simulator displays the General Preferences dialog box.

2. In the General Preferences dialog box, choose the options you want to change.

   You can change the specific type of preference by choosing the appropriate buttons on the left side of the dialog box.

3. Choose the OK button.

General Preferences



The General Preferences dialog box displays startup conditions. These are the initial preferences you chose during installation. Whatever changes you make here affect the way each Flight Simulator session starts.

You can also press the Q key to turn all sounds on and off.

Status At Startup Determines how Flight Simulator starts up. If you choose Normal Flight, Flight Simulator automatically opens the situation you specify when you choose the Startup Situation button. If you do not specify a startup situation, Flight Simulator opens the "Chicago Meigs Field Runway 36" situation. If you choose Demo Flight, Flight Simulator opens the demonstration you specify when you choose the Startup Demo button. If you choose No Sound Demo, the startup demonstration opens without sound.

Time At Startup Determines how your aircraft's instrument-panel clock is set. If you choose Use System Time, Flight Simulator sets the instrument-panel clock to your computer's clock. For example, if you start Flight Simulator at 10:15 at night, your aircraft's clock reads 22:15 and the view outside your cockpit is dark. If you choose Use Situation Time, the clock is set to the time when the situation was last saved. For more information on changing time in Flight Simulator, see "Changing the Time and Season" on page 84.

Sound At Startup Determines whether or not you hear sounds when you start Flight Simulator. For more information on the sound options, see "Sound Preferences" on page 11.

Dynamic Scenery At Startup Turns dynamic scenery on or off. For more information, see "Dynamic Scenery" on page 78.

Weather Generation At Startup Turns the weather generator on or off. In addition to fixed, programmable wind and clouds, there are random weather variations. For more information on the weather and automatic weather generation, see "Changing the Weather" on page 87.

Log Flight Time Determines whether or not Flight Simulator starts logging flight time when you first start flying. For more information on logging flight time, see "Logbook" on page 152.

Startup Demo Determines whether you start with the Flight Simulator preset demonstration or a demonstration you have recorded and saved.

Startup Situation Determines whether you start with the Flight Simulator preset startup situation, or a situation you have created and saved.

Situation Options Gives you the opportunity to always save certain options, such as Instrument Panel And View Window Positions, Aircraft, Scenery, Dynamic Scenery, and Weather, when you save your situations. You can also tell Flight Simulator to load specific options when you open each situation, such as Aircraft,

Scenery, and Keyboard, Mouse, and Joystick Sensitivities. For example, if you fly the Sopwith Camel over Seattle using the mouse as your control yoke, you can save and load this aircraft and your mouse sensitivities with the Seattle situation.

Display Preferences

Choose the Display button to open the Display Preferences dialog box, where you can change display options. For example, you can add wonderful visual effects, such as aircraft shadows and ground shadows, and sky texture for gradient hues that reflect the time of day, or you can see air traffic control communications as a continuous string of words across your screen. However, you'll need to weigh your decisions between image quality and speed. Keep in mind that the more visual complexity you add, the slower your screen display will be.

Sound Preferences

Choose the Sound button to open the Sound Preferences dialog box, where you can change the sounds you hear in Flight Simulator. Choose the Engine Sounds check box to hear the sound of your aircraft's engine or engines. Choose the Cockpit Sounds check box to hear a warning when your aircraft is about to stall, crash sound effects, or a beep when you get a message in dual-player flight. Choose the Navigation Sounds check box to hear the marker beacons when you are making an ILS landing approach. Sound affects display performance.

If you aren't familiar with the settings for your sound board, consult the documentation for your sound board before you attempt to change the sound preferences. For more information on sound, see "Sound" on page 198.

Keyboard, Mouse, and Joystick Preferences

Choose the Keyboard, Mouse, or Joysticks button to open the Keyboard, Mouse, or Joystick Preferences dialog box, where you can change the control sensitivities for Flight Simulator. The higher the sensitivity setting, the quicker the controls respond and the more difficult it is to control your aircraft. For example, if you set the aileron sensitivity to high, your aircraft turns as if you had power steering.
For more information, see Appendix A, "Using the Mouse, Keyboard, and Joystick," on page 202.

Country Preferences

In the world of flying, altitude is universally measured in feet, regardless of the units of measure commonly used in a country.

Choose the Country button to open the Country Preferences dialog box, where you can change the units of measure that Flight Simulator uses. You can choose from three options: U.S. System, Metric System with altitude in feet, or Metric System with altitude in meters (although internal values for metric conversion are correct, sometimes Flight Simulator rounds off display values to the nearest whole number). You can also change the hemisphere in which you want to set your latitude and longitude.

Instrument Preferences

Choose the Instrument button to open the Instrument Preferences dialog box. You can increase or decrease the rate at which your instruments reflect changes in flying attitude or controls. If you want your instruments to reflect changes as they happen, set the Gauge Update Rate to High. If you want to maximize the quality of scenery display, choose a lower setting.

If you need a definition or explanation of a term, check the Glossary on page 251.

You can also choose between a photo-realistic instrument panel and one that highlights the numbers on the gauges for enhanced readability. In addition, you can display indicated airspeed rather than true airspeed as you fly. For example, when you choose the Display Indicated Airspeed check box, you'll see lower airspeed readings at high altitudes because the air density is so low. If you choose the 25 kHz COM Frequency Adjustability check box, you can receive 720 radio channels with 25 kHz separation. For more information on the instruments and how to use them, see "Instrument Panel and Radio Stack" on page 43.

Quitting Flight Simulator

You can quit Flight Simulator at any time.

To quit Flight Simulator

- From the Options menu, choose Exit.

  You can also press CTRL+C, and then choose the OK button, or press CTRL+BREAK and exit directly to the MS-DOS prompt.

Flying Flight Simulator

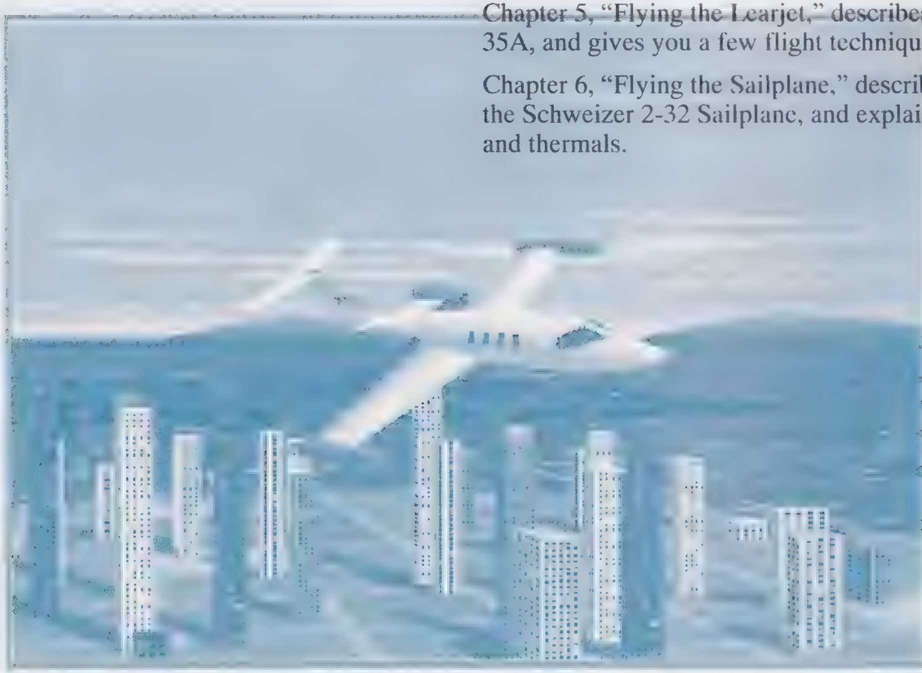
This section will teach you to fly by practicing: no books or lectures—we want you to start flying right away. First, you'll learn the basics of taking off and landing. Then you'll hone these skills and expand your knowledge by flying a single-engine aircraft, a Learjet, and a sailplane.

Chapter 3, "Flying Start," helps new pilots to take off and land. Taking off isn't so difficult, but putting the plane down safely on the runway is a bigger hurdle. Now you can learn while you land.

Chapter 4, "Flying the Single-Engine Aircraft," describes the instruments of a single-engine aircraft, such as the Cessna Skylane RG, and then teaches you how to taxi, take off, climb, turn, and land.

Chapter 5, "Flying the Learjet," describes the instruments and controls for the Learjet 35A, and gives you a few flight techniques.

Chapter 6, "Flying the Sailplane," describes the instruments and controls for the Schweizer 2-32 Sailplane, and explains how to stay aloft using ridge lift and thermals.



Chapter 3 Flying Start

For more Information on flying with the mouse in Yoke mode, see "Using the Mouse" on page 203.

If you're eager for your first flight—even before you read other parts of this manual—Flight Simulator now makes it possible to take off and land safely. We'll start you out with keyboard controls, but you can try flying with the mouse later and then decide which controls you like best.

To take off

Press the Q key to turn the sound on and off.

1 Make sure you are in your Flight Simulator directory, and then start Flight Simulator by typing **fs5** at the MS-DOS prompt.

You begin your flight looking out the cockpit of your Cessna Skylane RG at Meigs Field in Chicago.

2 Press SHIFT+KEYPAD 6 to change your view and look out the right side of the aircraft.

Notice your aircraft's wing at the top of the screen.

3 Press SHIFT+KEYPAD 2 to look out the back of the aircraft.

Notice your aircraft's tail with its flashing beacon in the center of the screen.

4 Press SHIFT+KEYPAD 8 to look straight out the front of your cockpit again.

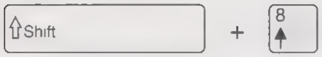
5 Press the PERIOD key to release the parking brakes.

6 Press KEYPAD 9 and hold it down until you are at full throttle.

Your aircraft starts rolling down the runway and the nose lifts up before the wheels actually leave the ground. This is called rotation. Rotation speed depends on the aircraft. It is around 50 knots for the Cessna.

7 Once you're airborne, press SHIFT+KEYPAD 2 to look out the back of the aircraft again.

You should see Meigs Field receding from view.



8 Press SHIFT+KEYPAD 8 to look straight out the front of your cockpit again.

Watch the instrument panel. Airspeed, altimeter, and vertical speed indicator gauges reflect movement.

9 Press KEYPAD 6 to bank your aircraft to the right.

The horizon tilts, as does the attitude indicator on your instrument panel. Don't bank too steeply.

10 After the aircraft starts to bank, press KEYPAD 5 to neutralize the ailerons and rudder and keep the plane on its current bank.

See how easy taking off is? You are now in the traffic pattern for a landing at Meigs Field.

To land using the Land Me command

The keyboard shortcut for the Land Me command is the x key. Use it to quickly turn Land Me on and off.

▶ From the Options menu, choose Land Me.

A check mark beside the command name indicates that Land Me is turned on. Watch for tips as your instructor explains what to do. Take control any time you are ready or give it back if you need help by choosing Land Me again.

When you are flying the Cessna, you can choose the Land Me command when you are near an airport and Flight Simulator will land your aircraft for you.

When you're ready to try a solo landing, choose Quick Practice from the Options menu.

Practice makes perfect. All pilots know that landing is one of the most difficult aspects of flying and that it takes many a landing to get the hang of it. Make it easy on yourself. Use the Land Me command until you understand the fundamentals, and then try landing on your own.

Chapter 4 Flying the Single-Engine Aircraft

For an in-depth description of flight instruments and aircraft controls, see "Instrument Panel and Radio Stack" on page 43, "Primary Flight Controls" on page 53, and "Secondary Flight Controls" on page 61.

This chapter takes you through the basics of flight. The procedures give you a gradual introduction to your aircraft and tell you how to check instruments, taxi, take off, climb, turn, descend, and land on your own.

The Quick Reference on the back cover of this manual is a handy guide for keyboard shortcuts. It contains all the keyboard commands you'll need. Keep it in front of you and refer to it often while flying Microsoft Flight Simulator. Keyboard and mouse controls are described in this tutorial. You'll find the corresponding actions for the joystick in Appendix A, "Using the Mouse, Keyboard, and Joystick," on page 202.

The single-engine aircraft simulation imitates the actions and responses of a real aircraft. It is closely patterned after a Cessna Skylane RG (basically a Cessna 182 with retractable landing gear) but you can also choose the Sopwith Camel for the single-engine aircraft simulation, even though the gauges and radios are limited. For a list of performance specifications for the Cessna Skylane RG and the Sopwith Camel, see Appendix C, "Performance Specifications," on page 235. You can also review the performance specifications for all Flight Simulator aircraft by choosing Aircraft from the Options menu, and then choosing the Performance Specs button.

If you need a definition or explanation of a term, check the Glossary on page 251.

Each time you fly an aircraft, you perform many of the same actions. You check the aircraft to make sure it is airworthy, note the environmental conditions so that you are aware of any potential problems, and follow a series of procedures to take off, climb, fly, and land. While many of these procedures are simple and straightforward, the variables involved in flying are what make it exciting.
Practice will make you a better pilot.

Flying Under Visual Flight Rule (VFR) Conditions

When you start Flight Simulator, you are facing north on the runway at Meigs Field (a small field on a peninsula that extends into Lake Michigan) in Chicago. The John Hancock building is on the horizon to your left (northwest). You will take off and climb out over Lake Michigan.

For more information on VFR weather minimums, see the chart on page 99.

You are lined up for immediate takeoff. The weather is fair. The clouds are high. There is no wind. This is perfect weather for visual flight rule (VFR) flying.

When you fly VFR, you rely on ground references and the visible horizon for orientation and navigation. Until you leave the ground, navigation is secondary to flight control. The most important instruments for your first VFR flight are the airspeed indicator and the altimeter. You will also use the primary flight controls, such as the ailerons, rudder, elevator, and throttle.

For your first flight, don't worry about making mistakes. You can always start over. It's more important to learn basic techniques now; later you can move on to more complex flying. Just concentrate on what you see out the window and how it relates to the aircraft's altitude, airspeed, and attitude.

Cessna Skylane RG Flight Characteristics

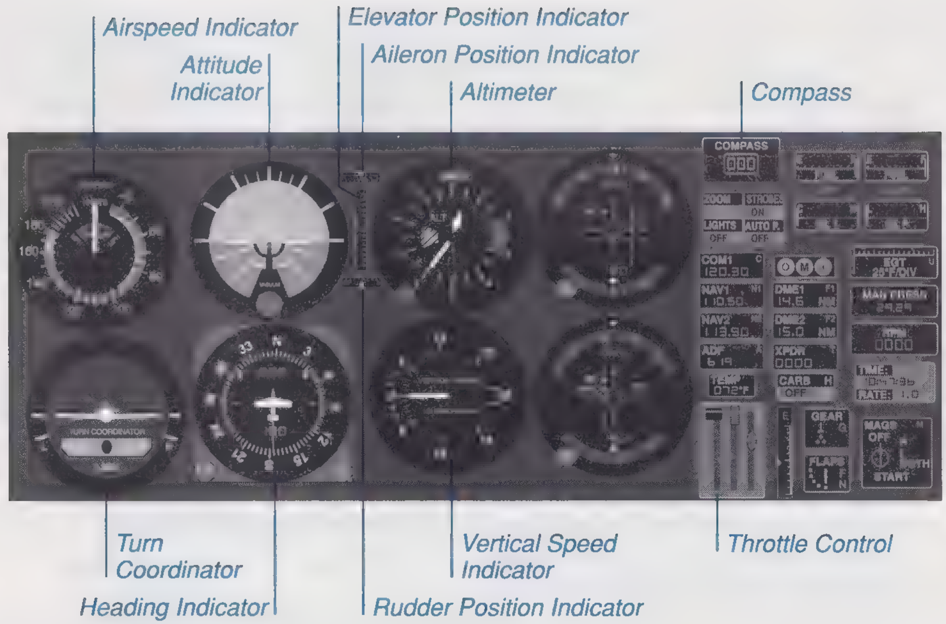
You can also fly the Sopwith Camel for the single-engine aircraft simulation. From the Options menu, choose Aircraft, and then choose Sopwith Camel from the list. For performance specifications for the Sopwith Camel, see page 238, or choose Aircraft from the Options menu, and then choose the Performance Specs button.

Your aircraft's engine starts automatically when you start Flight Simulator. Take a moment to study the three-dimensional display on your screen while the engine warms up. This is the front view out the aircraft's windshield. Now is also the time to do a pre-flight check before you take off.

To check your instruments

1 Check the airspeed indicator.

The airspeed indicator does not register a reading until the aircraft has reached a speed of 40 knots. When the airspeed indicator is not registering and the view from the cockpit does not change, you know your aircraft is standing still or moving very slowly. As you gain momentum taxiing down the runway, watch your airspeed increase.



2. Check the attitude indicator.

   It shows that your aircraft is positioned on the runway in a straight and level attitude. When you climb or descend, the center bar moves above or below the artificial horizon to indicate a nose-up or nose-down pitch angle. When you turn left or right, the artificial horizon tilts to the right or left to display bank.

3. Check your altitude.

   The altimeter measures altitude in feet above sea level. Although you have not yet left the ground, the altimeter shows an altitude of 593 feet, the elevation of Meigs Field.

4. Check the compass.

   It tells you that you are facing within three degrees of 0 (zero) degrees, or north. A 270-degree reading means that the aircraft is pointing west.

If you need a definition or explanation of a term, check the Glossary on page 251.

If you are using a VGA or EGA card, you can see additional instruments on the Cessna instrument panel by pressing the TAB key.

Click the right mouse button to switch between Pointer and Yoke modes. For more information on Pointer and Yoke modes, see "Using the Mouse" on page 203.

5 Check the heading indicator.

It shows your direction as 0 (zero) degrees. The compass and heading indicator provide similar, but not always identical, readings. The heading indicator gives a much more stable directional reading but, over a short period of time, gyroscopic precession and the earth's rotation cause the heading indicator to drift. When the Gyro Drift option in the Realism And Reliability dialog box on the Sim menu is turned on, you must adjust the heading indicator several times each hour to match the magnetic compass. To make this adjustment to the heading indicator, press D, the Directional Gyro key.

6 Check the turn coordinator.

It shows the rate of turn to the left or right. The ball in the lower part of the turn coordinator shows slip and skid, as a result of the aircraft's degree of coordination. Here, the turn coordinator indicates that your aircraft is not turning and is coordinated.

7 Check the vertical speed indicator.

It displays the speed at which you are gaining or losing altitude. Here, it indicates that your aircraft is not gaining altitude.

Using the Primary Flight Controls

The decision to fly using either mouse or keyboard yoke control is a matter of personal taste. Using the mouse most closely simulates using a control yoke, but you may find it easier to use the keyboard at first. Procedures for both mouse and keyboard control are described under "To move the control yoke and rudder" and "To taxi." The rest of this section assumes you are using the method you prefer.

To move the control yoke and rudder

1 Experiment with the ailerons. Click the right mouse button to switch to Yoke mode. Turn the yoke full left, then full right, by moving the mouse left and then right.
–or–
Adjust the ailerons by pressing KEYPAD 4 and KEYPAD 6.

When you're in the air, you use the ailerons to bank the aircraft about its longitudinal axis. When you're on the ground and there's a strong crosswind, you use the ailerons to keep the aircraft from being blown over.

The Auto Coordination command is checked when you start Flight Simulator. To learn more about using the ailerons and rudder in coordinated and uncoordinated flight, see "Auto Coordination" on page 52.

Notice how adjustments to the ailerons move the aileron position indicator. Notice that the rudder position indicator moves as well. In the air, you use the rudder to yaw the aircraft about its vertical axis. On the ground, the rudder controls turn the front wheel and you use them to steer the aircraft down the runway. In Flight Simulator, you can use Auto Coordination to make early flights easier. When the Auto Coordination command on the Sim menu is checked, the rudder and ailerons move together. When Auto Coordination is not checked, they move separately.

2. Apply up elevator and down elevator by moving the mouse forward and backward in Yoke mode. Notice how adjustments to the elevator move the elevator position indicator.
   –or–
   Apply up elevator and down elevator by pressing KEYPAD 2 and KEYPAD 8.

   You use the elevator to pitch the aircraft about its lateral axis, directing the nose of the plane up and down.

Keep the Quick Reference on the back cover handy. It lists most of the controls you'll need to fly.

3. Center the rudder and ailerons by pressing KEYPAD 5.

   Whether you prefer the mouse or the keyboard, use KEYPAD 5 to quickly center the rudder and ailerons.

Taxiing Around the Airport

You are on the runway, positioned for takeoff. Now's the time to practice your taxiing skills. While you are on the ground, you view all objects on the horizon straight on. It is best to use the map when taxiing around the airport because it gives you an overview of your surroundings.

To taxi

If you turn on Map View and it is not displayed, press the APOSTROPHE key to bring the map window to the front.

1. From the Views menu, choose Map View.

   Press the PLUS SIGN key on the main keyboard to decrease the viewing altitude and move closer to the runway. Press the MINUS SIGN key on the main keyboard to increase the viewing altitude and get more distance from the runway.

2. Make sure you release the parking brakes by pressing the PERIOD key, and then apply throttle to start taxiing.

With the mouse, you increase and decrease the throttle by holding down the left mouse button and dragging the throttle control up and down. With the keyboard, you increase throttle by pressing KEYPAD 9 and decrease throttle by pressing KEYPAD 3. For more information on keyboard controls, see Appendix D, "Keyboard Summary," on page 239.

You can always start over again by choosing Reset Situation from the Options menu or by pressing CTRL+PRINT SCREEN.

For now, a little bit is sufficient, so hold down the mouse button as you drag it forward about one-half inch, or press KEYPAD 9 five or six times until the aircraft just begins to move.

3 Use the rudder controls to steer the aircraft. Move the mouse left or right in Yoke mode to steer the aircraft down the runway, or press KEYPAD 4 or KEYPAD 6.

Try to keep the nose of the aircraft on the center line.

4 Get off the active runway as quickly as possible, and practice taxiing around the airport.

If you want to roll to a gentle stop, cut the throttle by dragging the mouse backward, or repeatedly pressing KEYPAD 3. Apply the brakes occasionally as needed by dragging the mouse slightly to the left or pressing the PERIOD key. If you need to make an abrupt stop, cut the throttle and apply your brakes continuously by dragging the mouse to the left or repeatedly pressing the PERIOD key.

Preparing for Takeoff

Now that you know how to taxi, it's time to prepare for takeoff. The pre-flight runup is a final check to make sure that your controls, instruments, and engine gauges are all operating properly.

To prepare for takeoff

1 From the taxiway, taxi to the end of the runway.

You can quickly cut the throttle by pressing the F1 key.

2 Cut the throttle, and coast to a stop at the line before the runway.

If necessary, apply your brakes.

3 Set the parking brakes by pressing CTRL+PERIOD.

4 Check elevator operation.

Move the elevator up and down, and then center it.

If you are using a VGA or EGA card, you can see additional instruments on the Cessna instrument panel by pressing the TAB key.

5 Check the rudder and ailerons in the same way, and then center them.

6 Check the engine gauges.

The oil pressure indicator should be centered between high and low ("in the green"). The fuel gauges should show full tanks.

The number at the end of the runway tells you in which compass direction you are heading (within the nearest 10 degrees). For example, runway 18 faces 180 degrees, or south.

7. Release the parking brakes by pressing the PERIOD key.
8. Finally, check for traffic, and then move onto the runway. Check the heading indicator against the magnetic compass. If they do not agree, set the heading indicator to match the magnetic compass by pressing D, the Directional Gyro key, after the magnetic compass has settled.

If all systems are go, you are ready for takeoff.

Taking Off

Before you take off, you may want to read the next sections on straight and level flight, turns, and glides and descents.

Taking off is an exhilarating event and it's easy. All you have to do is apply full throttle and keep your aircraft on the runway center line. In Flight Simulator, your aircraft lifts off of its own accord at rotation speed (unless you forget to reset the elevator trim to neutral after flying).

To take off

1. Move the map to an unused area of the screen, or turn it off by pressing the NUMLOCK key twice rapidly.
2. To ensure that you are looking out the front of your cockpit, press SHIFT+KEYPAD 8.
3. Apply full throttle.

   Be sure that the elevator is centered.

You can quickly apply full throttle by pressing F4. You can cut the throttle by pressing F1.

4. As you start down the runway, press KEYPAD 5 to center the rudder and keep your aircraft on the center line. Steer with the rudder only if you need to, making small adjustments to keep a steady course and to avoid zigzagging.

   Notice that the airspeed indicator shows the increase in speed. The runway drops away as you lift off. As the aircraft nose pitches up, the vertical speed indicator registers a positive reading.

Climbing

You can take a break at any time by pressing the P key to pause simulation.

The Flight Simulator aircraft, like a real aircraft, climbs by itself and does not require constant adjustments. If you take off as directed, you should climb steadily.

Pulling back on the control yoke (using up elevator) converts airspeed into vertical velocity.

To climb

1. Remain at full throttle.
2. Slowly pull back on the control yoke so that you get enough up elevator to hold a constant airspeed.

   As you raise the nose of your aircraft, watch how your airspeed is affected, as shown by the airspeed indicator.

Adjusting the Throttle

If you need a definition or explanation of a term, check the Glossary on page 251.

Do not attempt to increase or decrease climb rate by simply using up or down elevator without adjusting the throttle to maintain constant airspeed. Raising your nose (using up elevator) without increasing the throttle will increase your climb rate for a few seconds, but you will soon lose momentum, your airspeed will drop, and the aircraft may stall. On the other hand, increasing the throttle without applying up elevator will increase your speed, but not necessarily your rate of climb. The relationships between speed, vertical velocity, elevator, and throttle are complex and basic to successful flight. You will understand them only through practice.

Flying Straight and Level

Once you have reached an altitude of about 3000 feet (when the little hand of your altimeter points to the number three and the big hand points to zero), gradually make the transition from climbing to straight and level flight.

To level out

The vertical speed indicator measures the rate of climb or descent in hundreds of feet per minute. For example, a reading of 5 above the zero mark means you are climbing at 500 feet per minute.

1. Push the nose of your aircraft down (using down elevator) and decrease the throttle to attain a cruising speed of about 120 knots without gaining or losing altitude. Remember not to “chase” the vertical speed indicator. Instead, watch the altimeter and airspeed indicator respond as you make small adjustments in the throttle and elevator. Once you have settled into a straight and level flight pattern, your vertical speed is close to 0 (zero).
2. Check the altimeter periodically to make sure you are not losing or gaining altitude. If you are losing altitude, increase the throttle and apply up elevator. If you are gaining altitude, decrease the throttle and apply down elevator.

Turning with the Ailerons and Rudder

To learn more about using the ailerons and rudder in coordinated and uncoordinated flight, see "Auto Coordination" on page 52.

You turn by banking and yawing the aircraft in the direction you want. Use the ailerons to bank the aircraft. Use the rudder to yaw. To make early flights easier, the Auto Coordination command on the Sim menu is checked when you start Flight Simulator. This means the ailerons and rudder move together, so you use only the ailerons to control your bank.

To bank 20 degrees to the left

1. Move the ailerons slightly to the left.

   Your aircraft begins to bank left. Notice how the attitude indicator shows your bank attitude.

2. When the bank approaches 20 degrees, center the ailerons and rudder.

   Whether you prefer the mouse or the keyboard, use KEYPAD 5 to quickly center the rudder and ailerons.

3. Check the attitude indicator and turn coordinator again. You are still turning.

   You will continue turning at the specified angle until you "roll out" of the turn.

4. To roll out of the turn, apply the opposite or right aileron, until your attitude indicator shows that you are centered on your course.

   Timing is the most important factor in rolling out of a turn.

   As a rule, apply the opposite aileron and rudder when your heading indicator shows a reading 10 degrees short of your desired heading. It takes time to level your position. You are still in a bank while rolling out of a turn, so you continue to turn even as you level off. For example, if you want to proceed on a heading of 180 degrees, you should begin rolling out of the turn when the compass indicates a 170-degree heading.

5. Always check the altimeter after you have completed a turn.

   Turns cause you to lose altitude: the steeper the bank, the greater the loss. To compensate, apply a little up elevator as you are turning.

Gliding and Descending

Glides reduce altitude using little or no engine power. Proper glide technique is essential to a landing approach.

To climb, you increase the throttle and apply up elevator to increase altitude. To descend, you decrease the throttle and apply down elevator. To attain a proper glide attitude, however, regulate airspeed by raising or lowering the nose of your aircraft.

To practice gliding

- Climb to 5000 feet, level off, and cut the throttle.

  You will descend at a rapid speed. If your airspeed gets dangerously high (exceeding 140 knots), use a little up elevator. This raises your nose and helps control your airspeed.

For more information on flaps and how to use them, see "Secondary Flight Controls" on page 61.

You can also increase the angle of a glide and reduce airspeed by extending the flaps. This is particularly useful if you are too high on a landing approach. Flaps also decrease stall speed during approach and landing, enabling the aircraft to fly at lower speeds.

To practice descending

1. Climb to 3000 feet, level off, and slowly decrease the throttle.
2. Apply a bit of up elevator to hold constant airspeed and keep the nose from dropping. Keep an eye on the airspeed and attitude indicators; you don't want your descent to be too fast or steep.

Judging how much elevator to use takes experience. Watch the world outside when you decrease the throttle. Also study your pitch attitudes as you glide.

Head for Meigs Field and continue your descent until the altimeter reads 1000 feet above airport elevation (in this case, 1600 feet since the altitude at Meigs Field is 593 feet).

Landing

Correct and safe landing is the most challenging, and often the most difficult, part of flying. To land, you level off and fly a foot or two above the runway, slowly applying up elevator, until the aircraft settles onto the runway.

To land

1. Descend until you can see the runway.

   Every active runway has a number at each end. The line down the center of the runway is your guide for touchdown.

Use the axis indicator to help keep the aircraft lined up with the center line on the runway. For information on the axis indicator, see "Looking Out the Window" on page 65.

2 Pick your landing spot on the runway (either the runway numbers or the threshold markers), align yourself with it, and fly toward it at approximately 70 knots.

3 If you didn't raise your landing gear after takeoff, it is already lowered. Otherwise, lower it by pressing G, the Landing Gear key.

Choose Map View from the Views menu to help you line up your approach.

4 Decrease the throttle and use up elevator as necessary to maintain a 70-knot approach. Your approach glide should be a steep one. An engine failure during a steep glide will have little effect on where you land, whereas an engine failure during a long, shallow power glide could make you land short of the runway.

If you have difficulty lining up the aircraft for a landing approach, try increasing the magnification factor of the View 1 window to 2.0 to help you line up with the center line from a distance; then decrease the magnification factor to 1.0 as you near the airport. For information on changing the magnification of a view window, see "Zoom Control" on page 73.

5 Begin to make the transition to straight and level flight when you are approximately 50 feet above the runway, so that you will be in straight and level flight a foot or two above the runway. This procedure is called a flare.

When you flare, your airspeed starts to drop as the aircraft loses momentum. As the aircraft slows, the nose tends to drop.

6 Pull back on the control yoke (apply up elevator) to keep the aircraft a foot or two above the ground. As you do so, the nose rises. On touchdown, your elevator should be almost all the way up.

7 Make sure your rudder is straight before you touch down.

On the ground, the rudder controls turn the front wheel and you use them to steer the aircraft. You will be whipped off the runway if your wheels are not straight as you touch down. This is called ground loop and can severely damage an aircraft.

If you fly the aircraft onto the ground and you are above stall speed, your aircraft may bounce.

8 When you reduce your speed enough, the aircraft settles down onto the runway.

9 As you touch down, you hear the tires contact the runway and see the scenery on your screen level off. Press PERIOD, the Brakes key, to bleed off speed, steering the aircraft with the rudder controls. Continue to apply the brakes until you come to a complete stop.

One way to improve your landing technique is to practice with a Flight Simulator situation. From the Options menu, choose Situations, and then choose Final Approach To Meigs Field. You can also practice your landings by choosing Quick Practice from the Options menu.

Congratulations! You have successfully completed your first flight. If you need more practice on the fundamentals of flying before attempting advanced flight techniques, taxi to the end of the runway and prepare for takeoff again.

If Your Aircraft Crashes

If your aircraft crashes, you hear glass breaking as you hit the ground. If you land in water, you hear splashing sounds. In either case, Flight Simulator returns your aircraft to the location where you began the situation.

For more information on crash detection and analysis, see "Using Crash Detection" on page 148.

When you choose Crash Detection from the Sim menu, you can ask to see an analysis graph of your crash. You can also choose options that make crash effects more realistic.

Refueling and Servicing

Some airports have fuel and servicing facilities. The airports with fuel facilities have an asterisk (*) beside their name in Appendix B, "Sectionals, Directories, and Runway Maps," on page 211. At the airports in Flight Simulator, these facilities are displayed as rectangles near the ramp areas. Each rectangle has an "F" inside it. To refuel and have your aircraft serviced, come to a complete stop inside one of these rectangles. Both refueling and repairs take place immediately.

Chapter 5 Flying the Learjet

For information on flight instruments and controls, see "Instrument Panel and Radio Stack" on page 43, "Primary Flight Controls" on page 53, and "Secondary Flight Controls" on page 61.

The Learjet 35A includes aerodynamic enhancements that greatly improve its airflow and performance compared to earlier Learjets. In 1983, a Model 35A, captained by businesswoman-pilot Brooke Knapp of California, set a new speed record of 50 hours, 22 minutes, and 42 seconds total elapsed time for a flight around the world. In Flight Simulator, you can use the Learjet to go places and view scenery quickly, cruising at altitudes of up to 41,000 feet and at speeds up to 460 knots. The maximum operating speed is Mach .81.

Learjet Flight Characteristics

The Learjet 35A is a turbofan-powered aircraft. It is bigger than the Learjet 25, with a 13-inch increase in overall length and a 2-foot extension to each wingtip. For a complete list of performance specifications for the Learjet 35A, see page 236. You can also review performance specifications by choosing Aircraft from the Options menu, and then choosing the Performance Specs button.

Instruments for the Learjet

To see additional instruments on the Learjet 35A instrument panel, press the TAB key. Press SHIFT+TAB to switch between VOR 1, VOR 2, and the ADF gauge.

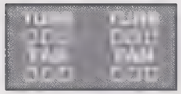
The turbofan engine was developed to convert more fuel energy into thrust. In principle, a turbofan engine operates in the same way as a turboprop engine, except that the turboprop's propeller is replaced by an axial-flow fan enclosed in a duct. However, instruments for a turbofan engine are different from those of a piston engine, such as the Cessna's. A Learjet 35A has two turbofan engines and two sets of engine instruments for turbine speed, turbine temperature, and fan speed. These and other Learjet 35A instruments that differ from those on the Cessna instrument panel are listed below.

If you need a definition or explanation of a term, check the Glossary on page 251.

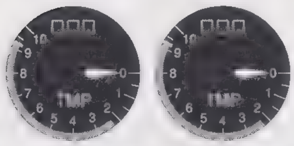
- The magnetic compass for the Learjet is located on a separate small instrument panel, or center post. You can turn off the center-post instrument panel by choosing Instrument Panel Options from the Views menu, and then turning off Instrument Panel 2.

If you want to display indicated airspeed, choose Preferences from the Options menu, and then choose the Instrument button and the Display Indicated Airspeed check box.

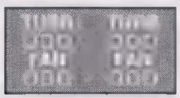
- The airspeed indicator on the Learjet 35A instrument panel is calibrated to read speeds up to Mach 1. (Mach 1 is the speed of sound: 1116 feet or 340 meters per second at sea level.) The airspeed indicator shows the true airspeed rather than traditional, or indicated, airspeed based on airflow. In the case of the Learjet 35A traveling at 45,000 feet near the speed of sound, true airspeed gives a good indication of how fast you are really moving.



- The two sets of turbine speed gauges (one rectangular and one round) display rpm for each engine in percent rpm. For your convenience, the turbine speed gauges are displayed on each subsection of the instrument panel.



- The two turbine temperature gauges display engine temperature for each engine in degrees Celsius.



- The two sets of fan speed gauges (one rectangular and one round) display the percent rpm of the fan for each engine. For your convenience, the fan speed gauges are displayed on each subsection of the instrument panel.

- The oil temperature gauge displays the temperature of the engine oil in degrees Celsius. There are two pointers on the gauge, one for each engine.

- The oil pressure gauge displays the pressure of the engine oil in pounds per square inch. There are two pointers on the gauge, one for each engine.

- The fuel flow gauge displays the engine fuel consumption in pounds per hour. There are two pointers on the gauge, one for each engine.

- The fuel quantity gauge displays the total fuel quantity on board in pounds. The Model 35A stores enough fuel to fly a transcontinental nonstop flight (925 U.S. gallons, 3500 liters, 770 Imp gal).

- The spoilers indicator displays the spoiler position. Spoilers are control surfaces on an aircraft's wing or body that disrupt the flow of air, slowing the aircraft down due to increased drag. Spoilers are used as in-flight speed brakes with the flaps up, or you can use them on the ground, just after touchdown. You can retract (RET) or extend (EXT) the spoilers by clicking the spoilers indicator on the instrument panel, or pressing the SLASH (/) key.

- The engines switch replaces the magnetos switch. This switch shows whether the left, right, or both engines are turned on. You can start the Learjet engines by clicking the engines switch on the instrument panel, or by pressing the J key, and then pressing the PLUS SIGN or MINUS SIGN key to cycle among Off, Start, and Gen (to use the engines as generators to power the Learjet's electrical systems). To shut down the Learjet engines, press CTRL+SHIFT+F1. To restart the fuel flow, press CTRL+SHIFT+F4.

For more information on realism and reliability, see "Special Features" on page 170.

  You can also choose the Realism And Reliability command on the Sim menu, and then choose the Flameout check box under Jet Propulsion Realism to see flameout when you fly the Learjet 35A at too high an altitude.

- The range on the vertical speed indicator is increased to measure a rate of climb of up to 6000 feet per minute.

- The pitch trim indicator replaces the elevator trim indicator. The direction of movement on the Learjet's pitch trim indicator is the reverse of what it is on the Cessna's elevator trim indicator. Nose-down trim is toward the top of the pitch trim indicator (DN) and nose-up trim is toward the bottom of the indicator (UP).
- There are two throttle controls on the Learjet (for the two engines). To choose which throttle control (and engine) you want to adjust, press E+1 for the left engine, E+2 for the right engine, or E+1+2 for both engines, and then drag the throttle lever with the mouse or press the throttle keys.

- Thrust reversers block and divert engine exhaust gases to slow the Learjet down during landing rollout. You can activate them by pressing the CTRL key and then pressing the F1 key to decrease the throttle. When the throttle control levers move into the red zones, the thrust reversers are on.

The rest of the instruments for the Learjet 35A function like those on the Cessna instrument panel.

Controls for the Learjet

The Learjet 35A and the single-engine prop aircraft use almost the same flight controls. The jet engines respond more slowly to throttle input because they need time to spool up to full speed.

The aileron and rudder sensitivity is a bit higher on the Learjet, and the ailerons can sometimes "get away" from you if the aircraft goes out of control. If the aileron indicator moves wildly and does not respond to the keyboard or mouse aileron controls, the aircraft is out of control.

To fly the Learjet

1. From the Options menu, choose Aircraft.

   Flight Simulator displays the Aircraft dialog box.
2. From the Aircraft list, choose Learjet 35A.
3. Choose the OK button.

   Unless you changed situations, you are now lined up for immediate takeoff, facing north on runway 36 at Meigs Field. The city of Chicago is on the horizon to your left (northwest). After you take off, you'll climb out over Lake Michigan.
4. Make sure to release the parking brakes by pressing the PERIOD key, and then apply full throttle by pressing F4.

Flight Techniques

There are three things to remember when you're flying the Learjet 35A:

- Fly it with a light touch—use slow, steady control movements.
- Don't exceed the Mach maximum operating speed (Mmo), which is Mach .81.

- Bring your airspeed down before landing. Even with thrust reversers and good brakes, the Learjet is heavy and can be hard to stop on the runway.

The Learjet 35A has a maximum takeoff weight of 18,300 pounds or 8391 kilograms. By comparison, the Cessna Skylane RG weighs only 3100 pounds or 1406 kilograms. Once an aircraft as heavy as the Learjet is on a given course and speed, it takes a lot of effort to slow it down or change its flight direction. This is particularly true of landings. The best way to land the aircraft is to reach the runway numbers with just the proper speed and sink rate. If you come in too fast, you float above the runway as the aircraft bleeds off speed. If your sink rate is too high, you hit the runway hard.

If you need a definition or explanation of a term, check the Glossary on page 251.

The Learjet is a streamlined aircraft, and its two Garrett TFE 731 turbofans with thrust reversers are powerful engines. The biggest problem you will have with this aircraft is too much speed. Mach .81 is the Mach maximum operating speed (Mmo). Exceeding Mmo activates the overspeed warning system.

For more information on controlling the response rate of your aircraft, see Appendix A, "Using the Mouse, Keyboard, and Joystick," on page 202.

The overspeed dangers cannot be emphasized enough. This aircraft is so powerful that you can easily exceed Mmo in level flight with full throttle. If you let the aircraft go too much over Mmo, supersonic shock waves travel back on the wings until they reach the ailerons. Since the aircraft uses mechanical linkage controls, the yoke (as shown by the aileron indicator) begins to shake and move wildly from side to side. At this stage, you are out of control.

Once you are out of control, don't use the spoilers to slow down. They will just drop the nose and make you go faster. Instead, recover by reducing the throttle and gently pulling back on the yoke. Too much yoke pressure causes stress to the wings, moving the shock wave back and making the controls shake even more violently. If all else fails, lower the landing gear. The Learjet can withstand the forces of gear down at high speed with only minor gear-door damage. The landing gear adds drag and helps stabilize the aircraft. It should slow you down enough so that you can regain control and fly the aircraft back to the airport for inspection and repairs, if necessary.

Chapter 6 Flying the Sailplane

The Schweizer 2-32 Sailplane is a non-powered, fully aerobatic sailplane that offers both easy handling characteristics and high performance, making it a fine aircraft for student pilots with an interest in enhancing their skills.

In Flight Simulator, you can watch a sailplane video with on-screen commentary to get an idea of how the sailplane flies. You'll find yourself ridge soaring northwest of the Golden Gate Bridge, near San Francisco. Below you are brown fields releasing heat that turns into columns of rising air—these are the thermals that lift your sailplane. An experienced instructor highlights the important flight concepts as you watch the aircraft soar.

To view a video of the sailplane

1. From the Options menu, choose Video Recorder.

   Flight Simulator displays the Video Recorder dialog box.
2. From the list of videos, choose Sailplane Soaring.
3. Choose the Play Selected Video button.

   Flight Simulator displays the Play Selected Video dialog box.
4. Choose the Repeat Replay check box if you want to automatically restart the video when it's over, and then choose the OK button.

If you want to stop the video at any time, press ESC.

Sailplane Flight Characteristics

You can also review performance specifications by choosing Aircraft from the Options menu, and then choosing the Performance Specs button.

Although the instrument panel for the Schweizer 2-32 Sailplane has a different look, the instruments are similar to those of the Cessna. The performance characteristics of this simulation closely match those of a real Schweizer 2-32 Sailplane. For a list of performance specifications for the Schweizer 2-32 Sailplane, see page 237.

Controls for the Sailplane

If you need a definition or explanation of a term, check the Glossary on page 251.

In addition to elevator, aileron, and rudder controls, the sailplane has terminal velocity dive brakes (spoilers), which you use to control your angle of descent. The dive brakes are surfaces that extend from within the wings to increase drag and reduce the efficiency of the wings. During a vertical dive, you can extend them to prevent the sailplane from exceeding its maximum safe speed. Extend or retract the

dive brakes by clicking the spoilers indicator (SPL) on the sailplane instrument panel or pressing the SLASH (/) key.

For information on flight instruments and controls, see "Instrument Panel and Radio Stack" on page 43, "Primary Flight Controls" on page 53, and "Secondary Flight Controls" on page 61.

To fly the sailplane

1. From the Options menu, choose Aircraft.

   Flight Simulator displays the Aircraft dialog box.
2. From the Aircraft list, choose Schweizer 2-32 Sailplane.
3. Choose the OK button.

   You'll see the sailplane instrument panel in front of you and the runway out your cockpit window.
4. Press the Y key to turn on the slewing controls.

   Notice the coordinates for your position and altitude in the upper portion of the display.
5. Press F4 to gain altitude rapidly.
6. Press F3 to stop gaining altitude (between 3500-4500 feet).
7. Press the Y key again to turn off slewing, and you'll begin to soar.

Flight Techniques

The sailplane has no engine for propulsion, so it is always descending unless you fly in an area of ascending air. When the air is rising at a rate equal to or greater than the sailplane's rate of descent, you can maintain your altitude or climb higher, depending on the strength of the lift and your level of skill. Guiding the sailplane through ascending air currents is very challenging, as the altitude and duration of your flight depend on your efficiency as a pilot rather than on the thrust of an engine. In Flight Simulator, you will find the two most common sources of ascending air—ridge lift and thermal lift—in the San Francisco scenery area.

Ridge Soaring

Ridge lift is caused by winds striking the side of a mountain ridge and deflecting upward. Thermal lift is caused by heated air rising from the landscape.

When wind blows into the side of a ridge, it deflects upward and creates a region of lift that can sustain the flight of a sailplane. As long as you guide the sailplane to the best areas of ridge lift and the wind continues in the appropriate direction and velocity, you can keep your sailplane aloft for hours and travel great distances.

To ridge soar

1. From the Options menu, choose Situations.

   Flight Simulator displays the Situations dialog box.

2. From the list of situations, choose Sailplane—Ridge Soaring, and then choose the OK button.

This flight situation releases you into the air currents that rise along the coast of Marin County, northwest of the Golden Gate Bridge in San Francisco.

The vertical speed indicator shows the rate at which you are ascending or descending, relative to sea level. For example, if the needle is on the second notch above 0 (zero), you are climbing at a rate of 200 feet per minute.

You will be heading southeast along the ridge, gradually ascending in rising air. The position of the sailplane relative to the top of the ridge is very important. If you fly too far out over the ocean, the air is neutral or descending because there are no hills to deflect the air upward. Avoid flying on the east side of the ridge, as the air flowing from the west becomes turbulent and descends as it spills over the top. You can usually find the best lift just in front of the ridge, but you should explore the ridge area and watch the vertical speed indicator to learn the areas of best lift.

As you approach the south end of the ridge near the Golden Gate Bridge, prepare to make a 180-degree turn by checking to your right for other aircraft. After confirming that your flight path is clear, turn to the right until you are headed northwest, guiding the sailplane slightly in front of the top of the ridge.

You can start your situation over again by choosing Reset Situation from the Options menu, or by pressing CTRL+PRINT SCREEN.

To stay in the lift when you reach the north end of the ridge, reverse direction again by turning 180 degrees left, away from the ridge, until you are heading southeast. To avoid flying into the ridge or turbulent air on the opposite side, always turn the sailplane away from the ridge instead of into it.

This flight path of figure eights is the usual flight pattern while ridge soaring. As your skills increase, try extending your flight range by gaining as much altitude as possible and then exploring the area. As you fly in areas away from the lift, keep in mind that you will need enough altitude to return to the ridge and work your way back up in the rising air. Don't let the sailplane descend too low or you may not have enough altitude to make it to the landing strip near the base of the north end of the ridge.

Thermal Soaring

One of the most challenging sources of rising air currents for the sailplane pilot is thermals. As the sun gradually warms the ground during the morning hours, some areas absorb heat more than others do; for example, forests and green fields absorb more heat than do desert areas or brown fields. Eventually, a brown field reflects

more heat than it absorbs and releases this heat into the atmosphere as a column of rising air. This thermal will rise for thousands of feet and become a cumulus cloud if there is sufficient humidity in the air.

To thermal soar

1 From the Options menu, choose Situations.

  Flight Simulator displays the Situations dialog box.

2 From the list of situations, choose Sailplane—Thermal Soaring, and then choose the OK button.

If your altitude becomes dangerously low, you can use the Slew command (and slew keys) or the Set Exact Location command on the World menu to return to a higher altitude. For information on how to use the slew keys, see "Slewing" on page 81. For information on the Set Exact Location command, see "Setting the Exact Location" on page 79.

Your sailplane is now in an area of thermal activity. By flying over dark-colored ground, you will probably encounter a thermal. When you do, the nose of the sailplane pitches up slightly, and the vertical speed indicator and altimeter indicate that you are climbing. Remember that there is more thermal activity during the early afternoon, when the ground has absorbed more of the sun's heat, than there is in the morning.

To avoid flying beyond the thermal and losing the lift, turn to the left or right to begin circling within the thermal. Thermal lift is strongest at the center of a thermal. To make efficient use of the lift, try to find the center of the thermal and stay there, circling with a 30- to 40-degree angle of bank. One popular method of locating the center of a thermal is the 270-degree correction. For example, if the left wing begins to rise, it is likely that a thermal is rising on the left side of the sailplane. By turning to the right 270 degrees, flying straight for a few seconds, and then circling in the same direction again, you can explore the perimeter of the thermal and locate the area of best lift.

Since the air within a thermal is rising and the air between thermals tends to be descending, you should generally fly slower while circling and faster while flying between thermals.

Flying in Another Area

You can also move the sailplane to a new location using the slew keys. For information on how to use the slew keys, see "Slewing" on page 81.

To fly the sailplane in locations other than the San Francisco area, take off in the Cessna, fly to the area you want, and then switch to the sailplane.

To fly the sailplane in another area

1. Take off in the Cessna and fly to the area where you want to try out the sailplane.

   Your airspeed should read between 70 and 80 knots.

2. From the Options menu, choose Aircraft.

   Flight Simulator displays the Aircraft dialog box.

3. From the list of aircraft, choose the Schweizer 2-32 Sailplane, and then choose the OK button.

For information on flight instruments and controls, see "Instrument Panel and Radio Stack" on page 43, "Primary Flight Controls" on page 53, and "Secondary Flight Controls" on page 61.

Because the Cessna's airspeed may be high for the sailplane, and cause it to climb rapidly, you must be ready to use the ailerons and elevator to control altitude when you switch aircraft.

To save your new sailplane location

1. When you are flying the sailplane, from the Options menu, choose Save Situation.

   Flight Simulator displays the Save Situation dialog box.

2. Type a title and a description for your situation. Press ENTER after you type each.

   For example, in the Situation Title box, type **SoarWA** and then press ENTER. In the Description box, type **Adventures in sailplane soaring east of the Washington Cascades** and then press ENTER.

3. Choose the Options button, and then choose the Aircraft check box.

   If you want to save any other options with this situation, choose them now.

Now, when you want to take your sailplane up and fly the thermals around Wenatchee, Washington, all you have to do is choose this situation, and you're there.

In and Out of the Cockpit

Now that you've learned the basics and logged in some hours behind the control yoke, it's time to advance your understanding and knowledge of flight systems and become a better pilot. If you want a closer look inside the cockpit to understand the intricacies of all those instruments you've been using, you've come to the right place. If you want to widen your perspective and scan the horizon from all angles so you can fly like an ace into the blue beyond your windshield, get ready!

Chapter 7, "In the Cockpit," describes how each instrument and aircraft control works individually and as part of the whole system that affects your aircraft's performance. You'll learn how to adjust flight instruments and controls using the mouse, keyboard, and joystick.

Chapter 8, "Looking Out the Window," describes the three-dimensional window views in Flight Simulator and offers hints on how to make the most of the available display choices.

Chapter 7 In the Cockpit

Flight Simulator includes all the instruments and equipment required under *Federal Aviation Regulations* (FAR, part 91.33) for day and night flying under visual flight rules (VFR) and instrument flight rules (IFR) under non-icing conditions.

For more information on instruments or controls for the Learjet 35A or the Schweizer 2-32 Sailplane, see "Flying the Learjet" on page 28 or "Flying the Sailplane" on page 33.

In this chapter, we use the Cessna Skylane RG instrument panel as our model, but keep in mind that instrumentation in Flight Simulator varies depending on the aircraft. We will discuss the instrument panel as a whole, as well as the individual instruments. We will also discuss primary and secondary controls. You will see how constant adjustments to both instruments and controls are your keys to smooth and safe flight.

Turning an Instrument Panel Off and On

If you want to test your ability to interpret visual cues or just enjoy the scenery around you, you can turn off the entire instrument panel. Flying without looking at your instruments for short periods of time is an important part of flight training. It helps you to get "the feel" of flying.

To turn an instrument panel off and on

For information on how to change the size of the three-dimensional window, see "Sizing and Moving a Window" on page 68.

1 From the Views menu, choose Instrument Panels.

  The instrument panel is no longer displayed in the lower half of your screen.

2 From the Views menu, choose Instrument Panels again.

  The instrument panel is displayed again. Notice that there is a check mark beside the command name when the instrument panel is turned on.

Choosing Instrument Panels and Instruments

The instrument panels for some of the Flight Simulator aircraft have subsections that include all the instruments, indicators, and controls that you need to fly. You can switch between these different subsections quickly and easily with the TAB key. For example, when flying the Learjet, press the TAB key to see the turbine speed gauges, the engines switch, the oil pressure and oil temperature gauges, and so on.

The Cessna, Sailplane, and Sopwith Camel each have only one instrument panel; they do not have multiple instrument panels. If you are using a VGA or EGA card, you can see additional instruments on the Cessna instrument panel by pressing the TAB key.

To switch between different sections of an instrument panel

- Press the TAB key.

Some aircraft also have multiple instrument panels. For example, the Learjet has two instrument panels. You can display both instrument panels, or you can turn off the compass center post so it doesn't block your view from the cockpit.

To turn off the Learjet compass center post

1. From the Options menu, choose Aircraft.
2. From the Aircraft list, choose Learjet 35A, and then choose the OK button.
3. From the Views menu, choose Instrument Panel Options.

   Flight Simulator displays the Instrument Panel Options dialog box with the Master Switch on—if you turn the Master Switch off, Flight Simulator does not display any instrument panels.
4. Choose the Off option next to Instrument Panel 2.

   On the Learjet, Instrument Panel 1 is the main instrument panel. Instrument Panel 2 is the compass center post.
5. Choose the OK button.

   Flight Simulator does not display the compass center post. Now you can fly with an unobstructed view of the scenery around you.

If your aircraft does not have multiple panels, Instrument Panels 2 and 3 are not available.

If you want to turn the compass center post back on, choose the On option next to Instrument Panel 2.

In Flight Simulator, you can also cover certain instruments so that you can practice flying without them, or make instruments malfunction so that you can practice flying in emergency conditions.

To cover instruments or make them malfunction

1. From the Views menu, choose Instrument Panel Options.

   Flight Simulator displays the Instrument Panel Options dialog box.

2. Choose the category of instruments you want:

   - Choose the Primary Instruments button to modify the functionality of the six primary flight instruments on the standardized instrument cluster.
   - Choose the NAV/COM Instruments button to modify the functionality of the radio equipment.
   - Choose the Aircraft Systems button to modify the functionality of systems that affect the entire aircraft: Pitot-Static (includes the airspeed indicator, vertical speed indicator, and altimeter), Vacuum (includes the attitude and heading indicators), Fuel, Engine, and Electrical.

For information on flight instruments and controls, see "Instrument Panel and Radio Stack" on page 43.

3. Choose the instrument or instruments you want to modify, and then choose Operative, Inoperative, or Covered.

   For example, if you want to test your ability to bank using visual cues alone, first choose the Primary Instruments button, next choose the Attitude Indicator, and finally choose Covered.

4. Choose the OK button to return to the Instrument Panel Options dialog box, and then choose the OK button again.

   Flight Simulator displays the instrument panel with your changes.

Use this feature to face the challenges of flying "partial panel" when you can't use some of the instruments, or to test your reactions when your instruments don't operate properly.

Instrument Panel and Radio Stack

For more information on how to move and size windows in Flight Simulator, see "Sizing and Moving a Window" on page 68.

The instrument panel and radio stack window occupy the lower half of the screen. You can move the instrument panel down by dragging the top border of the panel with the mouse. This makes room for a larger three-dimensional window or map in the upper half of the screen.

Instruments on the panel and radios in the stack are arranged as they would be in most aircraft. The six primary flight instruments indicate your airspeed, attitude, altitude, rate of turn, heading, and vertical speed. They are grouped together in the standardized instrument cluster. The radios are arranged in the radio stack. In addition, the instrument panel includes other instruments and indicators used in real aircraft, as well as those specific to Flight Simulator.

Cessna Skylane RG Instrument Panel

The following list identifies by name all the instruments, indicators, and controls on the Cessna instrument panel and includes page references to more specific information.

Standardized Instrument Cluster

1. Airspeed Indicator (page 45)
2. Attitude Indicator or Artificial Horizon (page 45)
3. Altimeter (page 45)
4. Turn Coordinator (page 46)
5. Heading Indicator or Directional Gyro (page 46)
6. Vertical Speed or Rate of Climb Indicator (page 46)

Radio Stack

7. COM Radio (page 46)
8. NAV 1 Radio (page 47)
9. NAV 2 Radio (page 47)
10. Distance Measuring Equipment (DME 1) (page 47)
11. DME 2 (page 47)
12. Automatic Direction Finder (ADF) (page 47)
13. Transponder (page 47)

Navigation Instruments

14. Magnetic Compass (page 47)
15. O (Outer), M (Middle), and I (Inner) Marker Lights (page 48)
16. Omni-Bearing Indicator (OBI) with Glide Slope (NAV 1) (page 48)
17. Omni-Bearing Indicator (NAV 2)/ADF (page 48)

Flight Instruments and Indicators

18. Zoom Indicator (page 48)
19. Lights Indicator (page 48)
20. Strobe Indicator (page 48)
21. Autopilot Status Indicator (page 48)
22. Outside Air Temperature (OAT) Gauge (page 48)
23. Clock (page 49)
24. Rate of Simulation Indicator (page 49)
25. Gear Indicator (page 49)
26. Flaps Position Indicator (page 49)

Control Position Indicators

27. Aileron Position Indicator (page 49)
28. Elevator Position Indicator (page 49)
29. Rudder Position Indicator (page 49)
30. Elevator Trim Indicator (page 49)

Other Flight Instruments, Indicators, and Controls

31. Left Wing Fuel Tank Gauge (page 50)
32. Right Wing Fuel Tank Gauge (page 50)
33. Oil Temperature Gauge (page 50)
34. Oil Pressure Gauge (page 50)
35. Exhaust Gas Temperature (EGT) Gauge (page 50)
36. Manifold Pressure Gauge (page 50)
37. Tachometer (page 50)
38. Throttle Control (page 50)
39. Propeller Control (page 50)
40. Mixture Control (page 51)
41. Carburetor Heat Indicator (page 51)
42. Magnetos Switch (Engines Switch on Learjet) (page 51)

Indicators on the 3-D Window

43. Axis Indicator (page 65)
44. Stall and General Warning Indicator (page 66)
45. Brakes and Status Indicator (page 66)

Standardized Instrument Cluster

Airspeed Indicator Measures the aircraft's speed through the air in knots. The airspeed indicator is an air-pressure-activated gauge. In Flight Simulator, the airspeed indicator initially measures true airspeed (TAS), or airspeed corrected for density altitude. For more realistic flights, you can display indicated airspeed (IAS) instead. IAS is the reading you get directly from the airspeed indicator. To display IAS, choose Preferences from the Options menu, and then choose the Instrument button and the Display Indicated Airspeed check box.

Attitude Indicator or Artificial Horizon Shows the aircraft's pitch and bank attitudes. Pitch is the rotation of the aircraft about its lateral axis (nose up or nose down). When the center bar of the attitude indicator is aligned with the horizon, you are flying in straight and level flight. Horizon movement above or below the center bar indicates nose-up and nose-down pitch angles.

Bank is the rotation of an aircraft about its longitudinal axis. When the center bar of the attitude indicator is aligned with the horizon, you are flying in straight and level flight. The artificial horizon tilts to the left or right to display the degree of bank.

Altimeter Measures altitude in feet above mean sea level (MSL). The gauge is affected by atmospheric pressure. You read the altimeter like a clock that has 10 divisions instead of 12. The large hand indicates hundreds of feet above sea level (in 20-foot increments), and the small hand indicates thousands of feet above sea level. The small arrow near the outside of the gauge indicates tens of thousands of feet above sea level.

Sea level is not the same as ground level. For example, at an airport with a 750-foot elevation, the altimeter registers 750 feet while the aircraft is sitting on the ground.

If you need a definition or explanation of a term, check the Glossary on page 251.

Barometric pressure changes caused by changes in the weather can lead to errors in altitude readings. Pilots must often calibrate the altimeter to the barometric pressure of the airspace through which they are flying. U.S. pilots calibrate to current air pressure at sea level in inches of mercury; European flyers calibrate to pressure in millibars. At an altitude above 17,999 feet, you must calibrate to standard pressure—29.92 inches of mercury, or 1013 millibars.

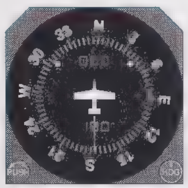
To automatically calibrate barometric pressure to the correct value, press the B key or choose Calibrate Altimeter from the Sim menu. To calibrate the altimeter manually, click the knob at the bottom of the altimeter to adjust your altitude. Barometric pressure is indicated in the small window on the right side of the gauge.

In Flight Simulator, this window is too small to plot the digits, so the window has fixed digits.

Turn Coordinator Measures turn rate and coordination. No numerical value appears on this gauge. Instead, a single turn-rate position is marked by the turn indicator (the small airplane symbol on the gauge). When the wing of the small airplane in the gauge aligns with the "L" (left) or "R" (right) indicator, you are in a two-minute turn. This means that the aircraft will complete a 360-degree turn in two minutes. The turn coordinator, unlike the turn indicator gauge used in some aircraft, uses a 35-degree canted gyroscope that reflects both bank and heading changes. Pitch, however, has no effect on the gauge. The turn indicator is useful for timed turns.

To learn more about coordinated and uncoordinated flight, see "Auto Coordination" on page 52.

The ball in the inclinometer at the bottom of the turn coordinator indicates both slip and skid attitude, or aircraft coordination. When the ball is centered, the aircraft's longitudinal axis is parallel to the direction of flight and the flight is coordinated. Coordinated turns are the safest turns. Some maneuvers, notably slips and skids, are not coordinated.



Heading Indicator or Directional Gyro Notes the direction of flight. The heading indicator is a gyroscopically controlled compass that, unlike a magnetic compass, has no inherent direction-seeking characteristics. It is much more responsive and steady than the magnetic compass. Using the magnetic compass, calibrate the heading indicator before each flight and a few times an hour while in flight.

To calibrate the heading indicator automatically, press the D key. To calibrate the heading indicator manually, click the left and right knobs at the bottom of the heading indicator to rotate left or right and adjust your heading. Always be sure that the magnetic compass has stabilized after a turn or after transition from climb-to-level flight to avoid setting a wrong heading.

Vertical Speed or Rate of Climb Indicator Measures rate of climb or descent in hundreds of feet per minute. This gauge operates on air-pressure changes and is not adversely affected by changes in barometric pressure. It lags slightly behind the aircraft's responses; avoid "chasing" (flying in direct response to) the vertical speed indicator to establish a constant altitude.

Radio Stack

COM Radio Transceiver that receives and transmits 360 channels at frequencies between 118.00 and 135.95 MHz, with 50 kHz separation. When you choose the Preferences command from the Options menu, and then choose the Instrument button, you can choose the 25 kHz COM Frequency Adjustability check box, and

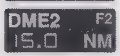
receive 720 channels with 25 kHz separation. Pilots can receive airport, weather, and approach information by tuning in automatic terminal information service (ATIS) at many airports.

NAV 1 Radio Used to tune in and identify very high frequency omnidirectional range (VOR) navigation aids. It also receives instrument landing system (ILS) frequencies.

For more information about radios and navigation instruments and how to set them, see "Navigation Course" on page 127.

The NAV radios receive 200 channels, at frequencies between 108.00 and 117.95 MHz, with 50 kHz separations. VORs are radio stations that transmit an omnidirectional synchronization signal. This synchronization signal is followed by a circular sweeping directional signal. The NAV receiver in your aircraft decodes these signals to determine the angle or radial you are on. You can think of radials as directional lines radiating outward from the VOR station like the spokes of a wheel. The NAV receiver also controls the omni-bearing indicator (OBI), which you can use to guide your aircraft along a radial as you move toward or away from a VOR station.

NAV 2 Radio Used to tune in and identify VOR navigation aids. You can tune in two VOR stations simultaneously so that you can cross-check your position.



Distance Measuring Equipment (DME 1 and 2) Works with the NAV 1 and 2 radios to tell you how many nautical miles you are from a VOR station.

Automatic Direction Finder (ADF) General navigation instrument used with nondirectional radio beacons (NDBs) or commercial AM radio stations to determine relative bearing. You can calculate the magnetic bearing to the NDB by adding the relative bearing to the aircraft's magnetic heading. The automatic direction finder (ADF) gauge can also occupy the position of the omni-bearing indicator (OBI) when you press SHIFT+TAB. See also Omni-Bearing Indicator (NAV2)/ADF later in this section.

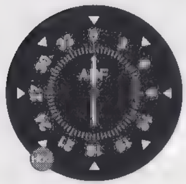
Transponder Transceiver used to identify your aircraft on air traffic control (ATC) radar.

Navigation Instruments

Magnetic Compass Standard magnetic compass used to determine direction.

O (Outer), M (Middle), and I (Inner) Marker Lights Lights that indicate when your aircraft is over the outer, middle, or inner marker beacons during an instrument approach using an instrument landing system (ILS).

Omni-Bearing Indicator (OBI) with Glide Slope (NAV 1) Landing approach and general navigation instrument used with the NAV 1 (Navigation) radio to tune into VOR radio beacons.



Omni-Bearing Indicator (NAV 2)/ADF Landing approach and general navigation instrument used with the NAV 2 radio. A glide slope is not available on this OBI. The automatic direction finder (ADF) gauge can also occupy this position when you press SHIFT+TAB. See also Automatic Direction Finder (ADF) earlier in this section.

Flight Instruments and Indicators

Zoom Indicator Indicates the magnification factor of the active window. The normal field of vision (without magnification) is 1.0.

Lights Indicator Indicates whether the navigation lights and instrument lights are on or off. Your lights should be on at night so the aircraft is visible to air traffic and ground observers and to enhance the lighting of the instrument panel. You can turn all aircraft lights on and off by clicking the lights indicator on the instrument panel or pressing the L key. You can turn the instrument panel lights on and off by pressing SHIFT+L. You can turn the landing light on and off by pressing CTRL+L.

Strobe Indicator Indicates whether the red flashing tail beacon is on or off. You can turn the beacon on and off by clicking the strobe indicator on the instrument panel or pressing the O key.

Autopilot Status Indicator Indicates whether the autopilot is on or off. You can turn the autopilot on and off by clicking the autopilot indicator on the instrument panel or pressing the Z key.

Outside Air Temperature (OAT) Gauge Displays air temperature outside the aircraft.

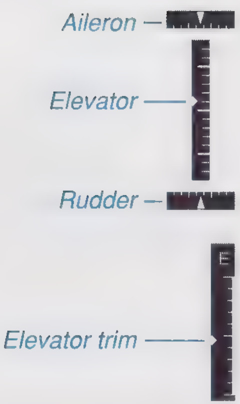
Clock Standard digital clock that runs in real time and measures hours, minutes, and seconds. Under 1982 FAA regulations, a digital presentation qualifies for instrument flight rule (IFR) flight in lieu of an analog sweep second-hand clock.
The Flight Simulator clock is very accurate. You set it by clicking the clock digits with the mouse or choosing Set Time And Season from the World menu.

Rate of Simulation Indicator Displays the rate of simulation. You change simulation speed by clicking the digits on the rate of simulation indicator with the mouse, or choosing Simulation Speed from the Sim menu.

Gear Indicator Indicates whether the landing gear is lowered or raised. In the air, you raise or lower the landing gear by clicking the gear indicator on the instrument panel or pressing the G key.

Flaps Position Indicator Displays the position of the flaps. Flaps extend outward from the fuselage to the midpoint of each wing. They always move in the same direction. When you extend the flaps, you change the pitch and airspeed of your aircraft. You use flaps most often to slow aircraft speed when landing.

Control Position Indicators



Aileron Position Indicator Indicates the position of the ailerons. The ailerons are airfoils, located on the trailing edge of the wing, that control the movement of the aircraft on its longitudinal axis. When the arrow on the indicator is aligned with the center mark, the ailerons are centered. When the arrow points to the right of the center mark, right aileron is applied, causing the aircraft to bank right; when the arrow points to the left, left aileron is applied, causing the aircraft to bank left.

Elevator Position Indicator Indicates the position of the elevator. The elevator is an airfoil on the trailing edge of the horizontal stabilizer that controls the movement of the aircraft on its lateral axis, pitching the aircraft nose up or down. When the indicator arrow is aligned with the center mark, the elevator is centered. When the indicator arrow is above the center mark, the elevator is raised; when below, the elevator is lowered.

Rudder Position Indicator Indicates the position of the rudder. The rudder controls the rotation of the aircraft about its vertical axis. When the arrow points to the right of the center mark, right rudder is applied; when the arrow points to the left, left rudder is applied. When Auto Coordination on the Sim menu is turned on, the aileron and rudder position indicators work together as a unit.

Elevator Trim Indicator Indicates elevator trim setting. When you trim the elevator, you make small adjustments to the elevator trim tabs. Trimming the elevator

correctly relieves the pressure you need to hold on the control yoke to keep the aircraft nose in the desired position.

Other Flight Instruments, Indicators, and Controls

If you are using a VGA or EGA card, you can see additional instruments on the Cessna instrument panel by pressing the TAB key.

Left Wing Fuel Tank Gauge Displays the amount of fuel in the left wing fuel tank.

Right Wing Fuel Tank Gauge Displays the amount of fuel in the right wing fuel tank.

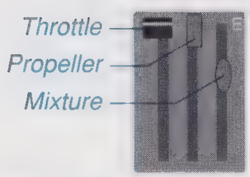
Oil Temperature Gauge Displays oil temperature.

Oil Pressure Gauge Displays oil pressure.

Exhaust Gas Temperature (EGT) Gauge Monitors engine performance and fuel-air ratio so you can get the most efficient fuel flow. This instrument is used in combination with the mixture control to get the mixture to the fuel-air ratio for continuous operation, as well as the best mixture for takeoff and climb. Watch the white needle on the EGT gauge as you make adjustments to the mixture control until it displays approximately minus 50 degrees of peak richness. At this point, you can set the yellow needle for your reference by pressing the U key, and then pressing the PLUS SIGN or MINUS SIGN key to move the needle forward or back.

Manifold Pressure Gauge Measures the air or fuel and air pressure in the intake manifold in inches of mercury. This instrument is used in combination with the tachometer to set up the desired power from the engine. When the engine is not running, the outside air pressure and the pressure in the intake manifold are the same, so that the manifold pressure gauge indicates the outside air pressure as a barometer would. When you start the engine and idle, the manifold pressure drops rapidly. As you open the throttle and allow more and more fuel and air to enter the engine, the pressure inside the manifold increases accordingly.

Tachometer Displays engine speed in revolutions per minute (rpm).



Throttle Control Controls aircraft engine speed. You can increase and decrease speed by dragging the throttle control up and down or pressing the F4, F3, F2, or F1 keys.

Propeller Control Changes the pitch of the propeller blades and regulates engine rpm. Select a low blade angle and high rpm setting for maximum thrust at takeoff. Use a higher pitch and lower rpm setting at cruising flight conditions to maintain

Before you can manually adjust mixture control and propeller control, you must choose Realism And Reliability from the Sim menu, and then choose the Mixture Control check box, and under Prop Advance choose Manual.

adequate thrust for the desired airspeed. You can increase and decrease the propeller angle by dragging the propeller control up and down or pressing CTRL+F4, CTRL+F3, CTRL+F2, or CTRL+F1. If you are flying in Yoke mode, you can increase and decrease the propeller angle by pressing CTRL, and then dragging the mouse up and down.

Mixture Control Controls the ratio of fuel-to-air mixture. A mixture that is too rich contains too much fuel for the existing conditions, and a mixture that is too lean does not contain enough fuel. You can make the mixture richer or more lean by dragging the mixture control up and down or pressing CTRL+SHIFT+F4, CTRL+SHIFT+F3, CTRL+SHIFT+F2, or CTRL+SHIFT+F1. If you are flying in Yoke mode, you can make the mixture richer or more lean by pressing CTRL+SHIFT, and then dragging the mouse up and down.

Carburetor Heat Indicator Indicates whether the carburetor heat is on or off. The carb heat system eliminates icing on internal engine surfaces, particularly at reduced power. You can turn the carburetor heat on or off by clicking the carb heat indicator on the instrument panel or pressing the H key.

Magnetos Switch Indicates whether the left and right magnetos are on or off. The magnetos can be switched on individually (left or right) or simultaneously (both). The magnetos supply electrical current to the spark plugs. You can change the magnetos position by choosing the Engine And Fuel command on the Sim menu; by clicking the magnetos switch on the instrument panel; or by pressing the M key and then pressing the PLUS SIGN or MINUS SIGN key to cycle among Off, Right, Left, Both, and Start. If you choose the Realism And Reliability command from the Sim menu, and then choose the Magnetos check box, you must start the engine yourself by first setting the magnetos switch to the Start position.

On the Learjet instrument panel, the engines switch replaces the magnetos switch. For more information on the engines switch, see "Instruments for the Learjet" on page 28.

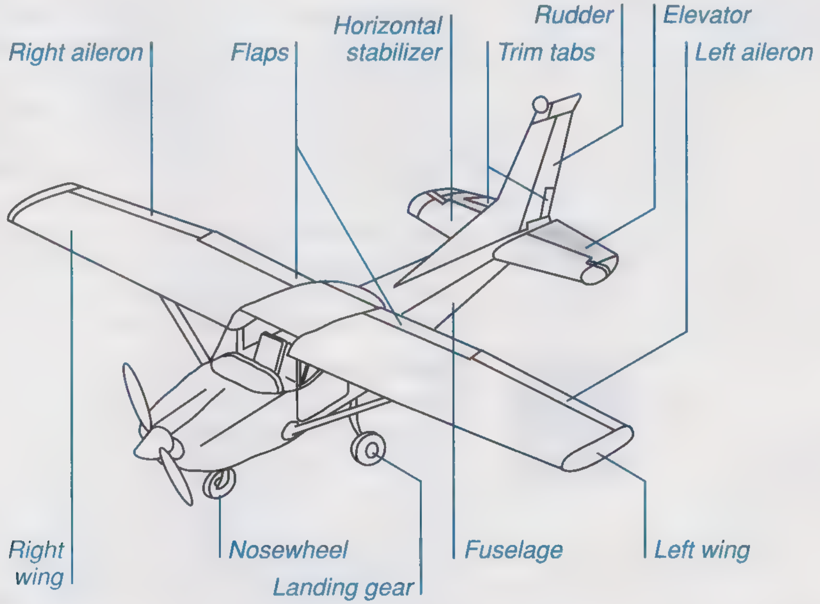
Aircraft Controls

Flight Simulator, like a real aircraft, has many controls that you use for safe, efficient flight, but you need only the primary flight controls to start flying. Once you learn how to use ailerons, elevator, rudder, throttle, and brakes, the sky and the runway lose their strange and foreboding quality and become familiar territory.

You can then refine your flying skills with the secondary controls. When you know how to use elevator trim and flaps, you'll handle the aircraft almost effortlessly.

Basic Aircraft Components

A keyboard or mouse are all you need to control Flight Simulator. You can also use one or two joysticks to increase realism. For installation and setup information, see Appendix A.



Auto Coordination

In Flight Simulator, you can use the Auto Coordination command on the Sim menu to make your early flights go smoothly.

When Auto Coordination is turned on, an aircraft is in coordinated flight—the aileron controls automatically move the rudder so that the aircraft makes coordinated turns with no slips. In uncoordinated flight (when Auto Coordination is turned off), you must control the rudder and ailerons separately. Unless you have two joysticks installed, you must use the rudder keypad controls to move the rudder—the aileron controls affect only the ailerons.

To practice flying with the Auto Coordination command turned off, see "Lesson 4. Uncoordinated Flight" on page 110.

To turn Auto Coordination off and on

1. From the Sim menu, choose Auto Coordination.

   When Auto Coordination is not checked, the ailerons and rudder move separately, which makes flying more difficult, but more realistic.

2. From the Sim menu, choose Auto Coordination again.

   When Auto Coordination is checked, the rudder and ailerons move together and you have one less control to think about.

Primary Flight Controls

The primary flight controls include the control yoke (a steering-wheel-like control on most planes, a control stick on others), the rudder pedals, the throttle, and brakes. These are the only controls you need to take off and fly.

In Flight Simulator, you can use the keyboard and mouse for all aircraft controls. You can also use one or two joysticks to increase realism. For installation and setup information, see Appendix A, "Using the Mouse, Keyboard, and Joystick," on page 202.

Control Yoke—Ailerons

The control yoke operates the ailerons and elevator, which guide the aircraft on its course.

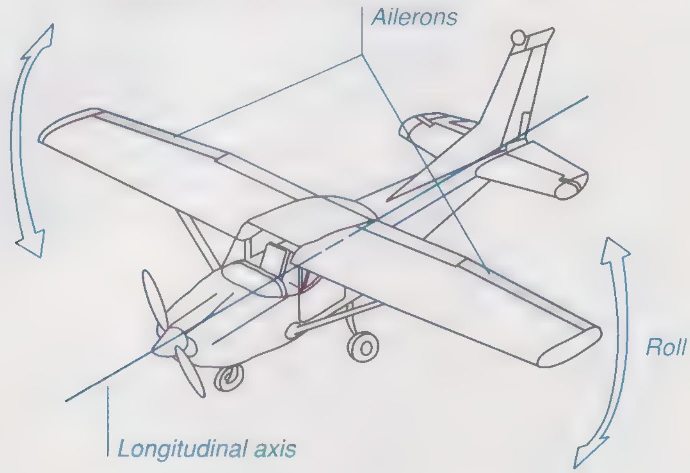
The ailerons, on the trailing edges of the wings, control the rotation of the aircraft about its longitudinal axis. Ailerons control bank, or roll. When you turn the control yoke to the left, you apply left aileron, which causes the aircraft to bank left; right aileron causes the aircraft to bank right. In Flight Simulator, the aileron position indicator shows the aileron setting.

Ailerons

Lowering aileron increases lift and raises wing.

Normal lift.

Raising aileron decreases lift and lowers wing.



The following illustration shows an aircraft in a 30-degree bank turn to the right (with Auto Coordination turned off). Note the attitude of the aircraft, the position of the aileron controls, and the response of the instruments.

Aileron Effects

In a 30-degree turn to the right, the aircraft banks into the turn, as shown in the picture. The instruments reflect the turn as follows:

Use right aileron by turning the control yoke to the right.

The attitude indicator shows that the aircraft is banking to the right.

The airspeed indicator remains constant.

The small airplane in the turn coordinator leans to the right, indicating the rate at which the nose is moving. The ball in the inclinometer moves to the right. Use right rudder or "step on the ball" to stabilize the aircraft.

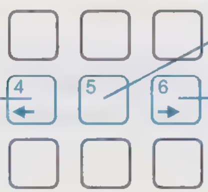
The vertical speed indicator remains constant.

The altimeter remains constant as long as you keep the nose of the aircraft even with the horizon.

The tachometer remains constant.

Aileron Controls

Keyboard (keypad control)

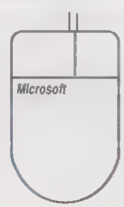


Center ailerons

Left bank (left aileron)

Right bank (right aileron)

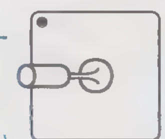
Move mouse to control ailerons



Left bank (left aileron)

Right bank (right aileron)

Move Joystick 1 to control ailerons



Left bank (left aileron)

Right bank (right aileron)

Control Yoke—Elevator

The elevator is an airfoil on the trailing edge of the horizontal stabilizer that controls the movement of the aircraft about its lateral axis, pitching the aircraft nose up or down. When you pull back on the control yoke, the nose of your aircraft moves up. When you push forward on the control yoke, the nose moves down. In Flight Simulator, the elevator position indicator shows the elevator setting.

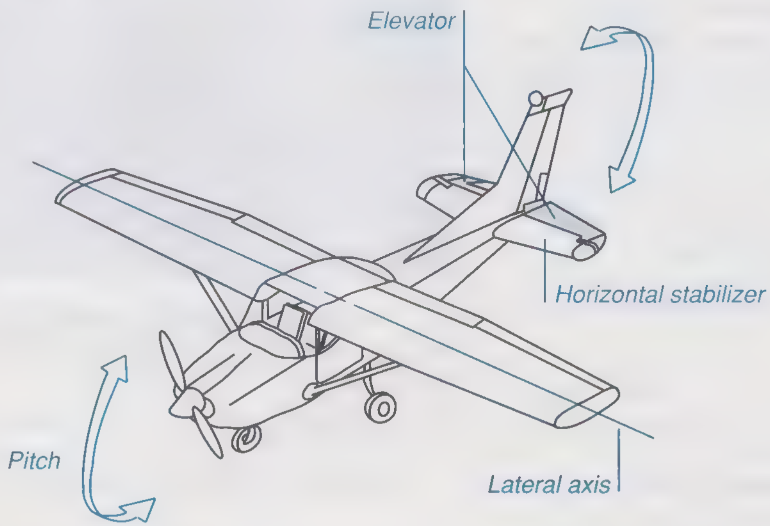
When you are using the keyboard, pressing the elevator keys in rapid succession makes broad, quick adjustments in elevator position. Pressing the elevator keys slowly, in at least one-quarter second intervals, moves the elevator by one-eighth of its normal adjustment.

Elevator

Lowering elevator moves the nose down (by forcing the tail up).

Neutral.

Raising elevator moves the nose up (by forcing the tail down).



The following illustration shows an aircraft in a climb. Note the attitude of the aircraft, the position of the elevator controls, and the response of the instruments.

Elevator Effects

In a climb, the nose of the aircraft pitches up, as shown in the picture. The instruments reflect the climb as follows:

Raise the elevator to start the climb, and the arrow on the elevator position indicator moves above the center mark.

The attitude indicator shows the nose of the aircraft pointing above the horizon.

The airspeed indicator shows a decrease in airspeed as the aircraft climbs.

The turn coordinator remains centered.

The vertical speed indicator shows an increase in the rate of climb.

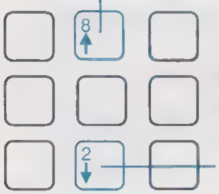
The altimeter indicates an increase in altitude.

The tachometer shows a decrease in RPM.

Elevator Control

Keyboard (keypad control)

Nose down (elevator down)

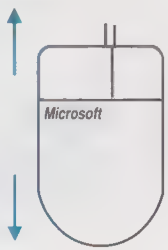


Note: Rapid keystrokes cause movements eight times as large as slow keystrokes. Use slow keystrokes for fine adjustments.

Nose up (elevator up)

Move mouse to control elevator

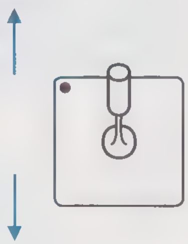
Nose down (elevator down)



Nose up (elevator up)

Move Joystick 1 to control elevator

Nose down (elevator down)



Nose up (elevator up)

Rudder

When the Auto Coordination command on the Sim menu is turned on, the rudder and ailerons move together. For more information, see "Auto Coordination" on page 52.

The rudder, located on the vertical stabilizer, controls the rotation (yaw) of the aircraft about its vertical axis. You use the rudder to move the aircraft's nose left and right, and you use the rudder and ailerons in conjunction with each other to initiate a turn. You also use the rudder to steer the aircraft down the runway. In Flight Simulator, the rudder position indicator shows the rudder setting.

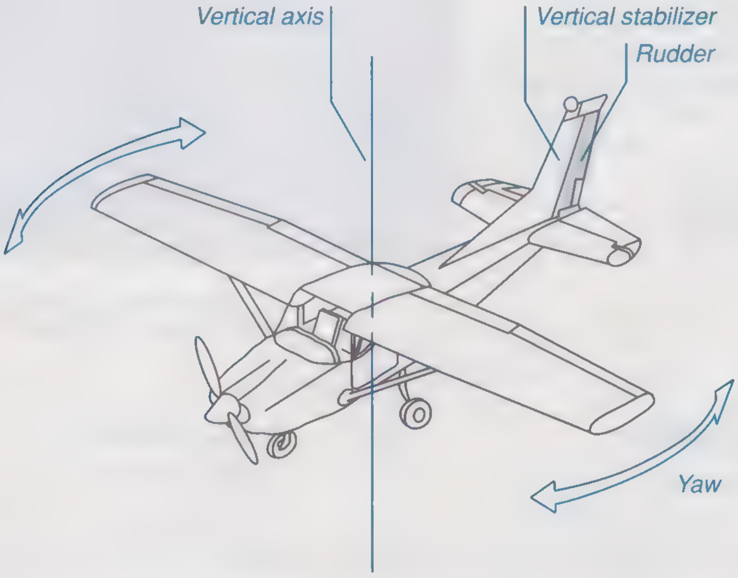
The rudder controls are the bottom-left and bottom-right keys on the numeric keypad. On some keyboards, the bottom-right key is the PLUS SIGN; on others, it is the ENTER key. Ignore the keycap legend and always use the bottom-right key for right rudder.

Rudder

Moving rudder to the left yaws the aircraft to the left (by forcing the tail to the right).

Neutral.

Moving rudder to the right yaws the aircraft to the right (by forcing the tail to the left).



The following illustration shows an aircraft yawing to the right (with Auto Coordination turned off). Note the attitude of the aircraft, the position of the rudder controls, and the response of the instruments.

Rudder Effects

Yawing to the right turns the nose of the aircraft to the right, as shown in the picture. The instruments reflect yawing as follows:

The altimeter remains constant as long as you keep the nose of the aircraft even with the horizon.

Use right rudder to move the nose to the right.

The attitude indicator banks slightly to the right or remains constant.

The airspeed indicator remains constant.

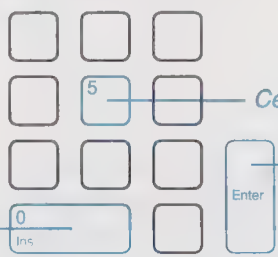
The small airplane in the turn coordinator tilts slightly to the right, indicating the need to apply aileron for a proper, coordinated turn. The ball in the inclinometer moves to the left. Use left rudder or "step on the ball" to stabilize the aircraft.

The vertical speed indicator remains constant.

The tachometer remains constant.

Rudder Controls

Keyboard (keypad control)



Center rudder

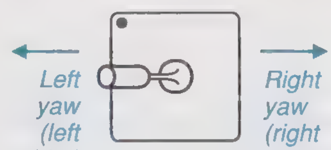
Left yaw (left rudder)

Right yaw (right rudder)

Mouse

You can only control the rudder with the keyboard or a joystick.

Joystick 2 (when set to Throttle And Rudder)



Left yaw (left rudder)

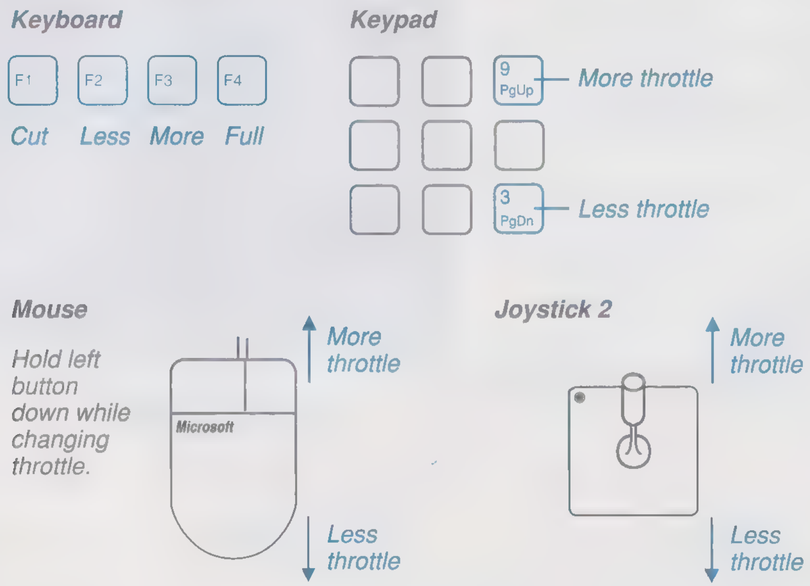
Right yaw (right rudder)

Throttle

When using KEYPAD 9 or KEYPAD 3 for more or less throttle, respectively, note that rapid, multiple keystrokes move the throttle up and down quickly, while single, slow keystrokes produce finer adjustments.

The throttle controls engine speed by regulating the amount of fuel and air that flows into the cylinders. Pushing the throttle forward, or opening it, increases the aircraft's power. Pulling the throttle back decreases the aircraft's power. In Flight Simulator, the throttle control on the instrument panel shows the throttle setting.

Throttle Controls



Brakes

Flight Simulator also offers differential braking so that you can operate the left and right brakes independently of each other. Press F11 for the left brake and F12 for the right brake.

The brakes slow the aircraft while it is on the ground. These are wheel brakes only and have no effect in the air. (Brakes are automatically released while in the air to avoid landing with them on.) To slow the aircraft, press and hold the PERIOD key on the bottom row of the main keyboard. Each keystroke reduces speed by a few knots. When applying the brakes using the PERIOD key, there is no need to release the brakes, because they only stay on for a few seconds after each keystroke.

You can use the parking brakes when you are fueling your aircraft or stopping for a while. To set the parking brakes, press CTRL+PERIOD. To release the parking brakes, press the PERIOD key.

When you set the parking brakes or apply the brakes, Flight Simulator displays a parking brakes or brakes indicator in the lower-left corner of the three-dimensional window.

Brake Controls

Brakes are effective only while your aircraft is on the ground.

Keyboard

[> .] *Apply brakes (or release parking brakes).*

[F11] [F12] *Apply differential brakes.*
Left *Right*

[Ctrl] + [> .] *Apply parking brakes.*

Joystick 2

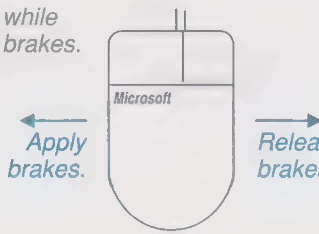
Apply brakes.

Release brakes (right of center or centered).

Mouse

Hold left button down while using brakes.

Apply brakes.



Release brakes.

Secondary Flight Controls

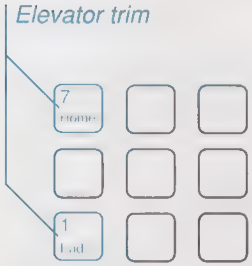
Once you're familiar with the primary flight controls that you need to fly your aircraft, you can turn your attention to the secondary controls, which you use to refine your flying skills and make your flights smoother and easier.

Elevator Trim

The control yoke is directly connected to the airfoils it controls. Different flight attitudes put different pressures on the airfoils. These variations also change the pressure on the yoke. The pilot must counteract these forces to keep the airfoils in their proper positions. Applying steady pressure on the yoke for hours would be tiring. Trim is used to counteract these forces and relieve the pilot of applying constant pressure on the yoke. Some pilots say that if you trim an aircraft properly, it will fly on its own.

The moving surfaces on the trailing edge of the elevator control elevator trim. In Flight Simulator, pressing KEYPAD 7 adjusts the trim downward (nose-down trim), and pressing KEYPAD 1 adjusts the trim upward (nose-up trim). The elevator trim position indicator shows elevator trim position.

Elevator Trim Controls



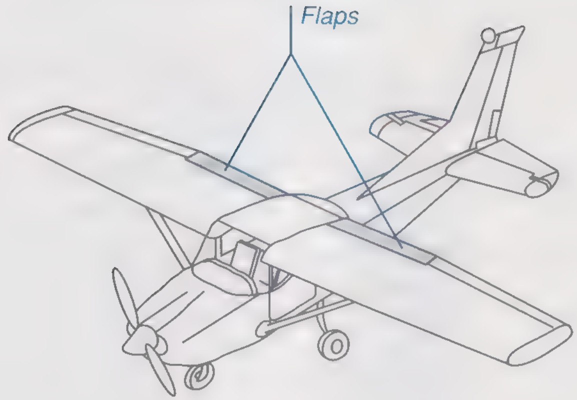
Flaps

Flaps are movable panels on the inboard trailing edges of the wings. They are hinged so they can be extended downward into the flow of air beneath the wings to increase lift (upward force) and drag (rearward pull). The primary purpose of the flaps is to permit a slower airspeed during a landing approach. You can also use the flaps to shorten takeoff distance or decrease stall speed on a landing approach.

Extending and retracting the flaps affect an aircraft's performance considerably. Extending the flaps increases both lift and drag. This increases glide angle, which is particularly useful if you are flying too high on a landing approach and want to increase your rate of descent. You can also reduce airspeed by extending the flaps. In Flight Simulator, the flaps position indicator shows the position of the flaps.

Flaps

Lowering flap increases lift (upward force) and drag (rearward pull).



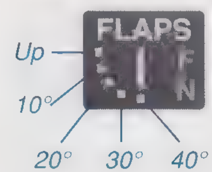
Flap Controls

You can adjust the flaps with the keyboard or the mouse. Flaps in the up position are totally retracted; in the 40-degree position, they are totally extended.

Keyboard

F5	F6	F7	F8
Up	10°	30°	40°

Mouse



In the flaps position indicator on the instrument panel, click the required flap position.

Using the Mini Controls

For information on how to change the size of the three-dimensional window, see "Sizing and Moving a Window" on page 68.

The Mini Controls are displayed in a small floating window that indicates the position of the flight controls (elevator, ailerons, rudder, and throttle) and the aircraft's airspeed. The Mini Controls are useful if you want to fly with a full-screen three-dimensional view and no instrument panel.

To turn the Mini Controls on or off

1. From the Views menu, choose Mini Controls.

   Flight Simulator displays the Mini Controls in the upper-right corner of your screen. Notice that there is a check mark beside the command name when you turn on the Mini Controls.

2. From the Views menu, choose Mini Controls again.

   The Mini Controls are no longer displayed.

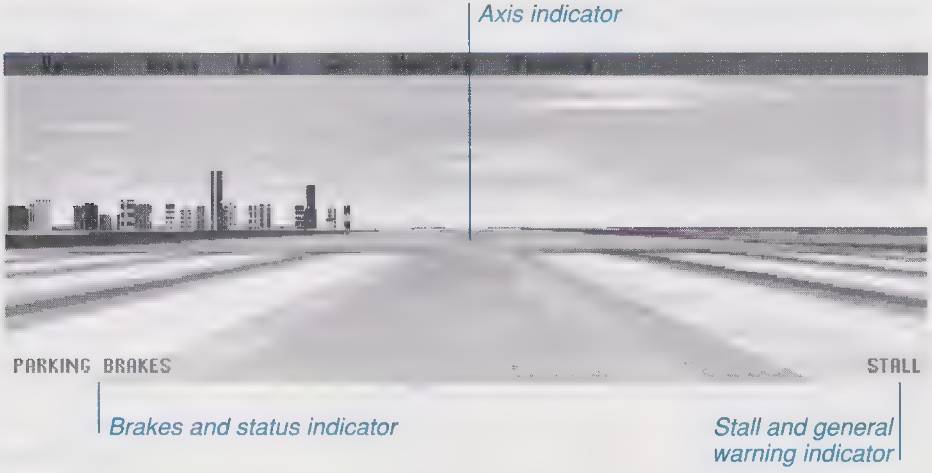
When the Mini Controls are displayed, a square in the center of the cross (which is the aileron and elevator indicator) moves from left to right to show aileron movement, and from top to bottom to show elevator position. The throttle indicator is on the right. Two small rectangles represent the current throttle setting: a top position shows full throttle; a bottom position shows no throttle applied. The rudder indicator, below the aileron and elevator indicator, represents the current rudder setting. The aircraft's airspeed in knots is displayed at the bottom of the window.

Chapter 8 Looking Out the Window

For more information on changing your view, see "View Controls" on page 66.

In Flight Simulator, a three-dimensional window occupies the top half of your computer screen. In this window, you can choose to view the runway, its surrounding terrain, and the horizon through your cockpit windshield, from a spotter plane, or from the airport control tower. You can also see more than one view at a time.

Flight Simulator's visual effects are very realistic and can be quite dramatic. Three-dimensional views, the instrument panel, and a map view are presented in color if your monitor has that capability. The sky glows at sunrise and sunset in gradient hues. During the day, clouds may darken the sky and obscure your vision until you break through to the other side. At night, lights on the ground and stars in the sky are your only visual references.



The following indicators are displayed in the three-dimensional window.

The axis indicator is especially helpful for aligning your aircraft with the runway during landing approaches.

Axis Indicator This indicator is a V-shaped bar that shows the current axis of your aircraft. This bar gives a good indication of where the aircraft's center is pointing and is especially useful when in unusual attitudes. Note that this is not necessarily the direction in which the aircraft is flying. You can turn the axis indicator on and off or change its shape by choosing View Options from the Views menu, and then choosing the Axis Indicator option.

Stall and General Warning Indicator This indicator displays a "STALL" message and gives an audible warning when your aircraft is less than five knots above stall speed (the speed at which an aircraft's wing stalls). An "OVERSPEED" message is displayed here when a jet is exceeding its maximum safe operating speed.

For information on how to use your aircraft's brakes, see "Brakes" on page 60.

Brakes and Status Indicator This indicator displays a "PARKING BRAKES" message when you set the parking brakes and a "BRAKES" message when you apply the brakes. These are wheel brakes only and have no effect in the air. Messages concerning current program status are also displayed here: "VIDEO" indicates that a video is being played; "Video Recording Rate: 1 Second" and "Video Recording Rate: 5 Seconds" indicate the interval at which you are recording a video; "REPLAY" indicates that instant replay is in progress; and "PAUSED" indicates that you have paused the simulation.

View Controls

For information on how to zoom in or out, see "Zoom Control" on page 73.

Flight Simulator has a sophisticated viewing system. You can display two three-dimensional windows on the screen, each with a different zoom factor. In either window you can view your surroundings from your aircraft's cockpit, or see your own aircraft as it looks from the control tower or from a spotter plane. You can also display a map window on the screen so that you can see details of the area in which you are flying or taxiing.

You can switch windows or change views with the keyboard or the Views menu. Keyboard shortcuts for View 1, View 2, and Map View are listed beside the command name on the Views menu. A check mark beside the command name indicates that the command is turned on.

The following table explains the window and viewing commands on the Views menu.

Choose	To
View 1	Turn the first 3-D window on or off. When you start Flight Simulator, View 1 is set to Cockpit view.
View 2	Turn the second 3-D window on or off.
Map View	Turn the map window on or off.
Instrument Panels	Turn the instrument panel on or off.

If you turn on View 2 (or Map View) and it is not displayed, press the APOSTROPHE key to bring the window to the front.

Choose	To
Instrument Panel Options	Choose instruments to display on the Instrument Panel. For more information, see "Choosing Instrument Panels and Instruments" on page 41.
Mini Controls	Turn the Mini Controls on or off. For more information, see "Using the Mini Controls" on page 63.
Set Spot Plane	Specify where the spot plane flies and how it follows you when you do aerobatics. For more information, see "Setting the Spot Plane" on page 71.
View Options	Turn views on or off, change view directions, change zoom factors, turn the axis indicator on or off, add titles to windows, or maximize the external 3-D views. For more information, see "Choosing View Options" on page 69.
Maximize Window	Make the active window take up the whole screen.
Size And Move Windows	Change the size of windows or move them.

Making a Window Active

You can have three different views in three different windows on your screen, but only one window is active at any time. You need to make a window active when you want to do anything in that window. For example, if you want to change View 1 from Cockpit view to Tower view, you must make the View 1 window active before you can change your view.

To make a window active

- Click anywhere in the window.
  –or–
  From the Views menu, choose the window you want (View 1, View 2, or Map View).
  –or–
  Press the OPENING BRACKET ([) key to make View 1 active; press the CLOSING BRACKET (]) key to make View 2 active; or press the NUMLOCK key to make Map View active.

If you turn on View 2 (or Map View) and it is not displayed, press the APOSTROPHE key to bring the window to the front.

When in Tower or Spot view, you can turn on the Full Screen External View option so that you always see a large area when you switch to these views. Choose View Options from the Views menu, and then choose the Full Screen External View check box. Full Screen External View is not displayed in Cockpit view.

Sizing and Moving a Window

You can change the size and position of your three-dimensional windows to give you a better view of your flight area.

To maximize a window

1. From the Views menu, choose Maximize Window.
   –or–
   Press the W key.

   The active window is displayed immediately at full-screen size.
2. Choose Maximize Window again to reduce the active window to its previous size.
   –or–
   Press the W key again.

To size a window with the mouse

1. Drag the lower-right corner of the window you want to resize.

   Flight Simulator shows the window changing size as you drag.
2. Release the mouse button when the window is the size you want.

To move a window with the mouse

▶ Drag the top border of the window you want to move.

You can change the size of View 1, View 2, and Map View, but you can't change the size of the Mini Controls or instrument panels.

To size or move a window with the keyboard

1. From the Views menu, choose Size And Move Windows.

   Flight Simulator displays the Size And Move Windows dialog box.
2. Choose the button that corresponds to the window you want to size or move.

   For example, choose the Map View button if you want to make the map larger or move it.

   Flight Simulator displays the window you choose.
3. Press SHIFT+ the arrow keys to change the size of a window.
   –or–

Press the arrow keys to move a window. For example, press SHIFT+DOWN ARROW if you want to make the window larger.
–or–
Press DOWN ARROW to move the window down.

4 Press the ESC key to return to the Size And Move Windows dialog box.

5 Choose another button if you want to size or move a different window.
–or–
Choose the OK button when you have finished sizing or moving your windows.

Choosing View Options

Use the View Options command on the Views menu to choose views for each of the three windows (View 1, View 2, and Map View). You can choose from Cockpit, Tower, Track (in dual-player flight only), or Spot views.

To choose a view with the Views menu

1 From the Views menu, choose View Options.

Flight Simulator displays the View Options dialog box.

2 Choose a window (View 1, View 2, or Map View).

3 Choose the View box, and then:

Choose	To see
Cockpit	Out the aircraft's windshield.
Tower	The airport from the control tower. You can watch the runways and the airspace around the airport, keeping your aircraft in view.
Track	Another aircraft from your cockpit. You can only use this view when you are in dual-player flight. For more information, see "Dual-Player Flight" on page 158.
Spot	Your airplane, as viewed from a chase-type spotter aircraft. Use the Set Spot Plane command on the Views menu to specify the position of the spotter aircraft. For more information, see "Setting the Spot Plane" on page 71.

You can also use the keyboard to cycle through the available views.

S *Press to cycle through Cockpit, Tower, and Spot views.*

To choose a view with the keyboard

- Press the S key to cycle through Cockpit, Tower, and Spot views.

  You can press SHIFT+S to cycle through the views in reverse order. Remember, you can only use Track view in dual-player flight. For more information, see "Dual-Player Flight" on page 158.

A good way to immediately know which view you are looking at is to display view titles on your windows.

To display view titles on your windows

1. From the Views menu, choose View Options.

   Flight Simulator displays the View Options dialog box.
2. Choose the Titles On Windows check box.
3. Choose the OK button.

   Flight Simulator adds a title in the upper-left corner of the window to let you know which view you are looking at.

Choosing a View Direction

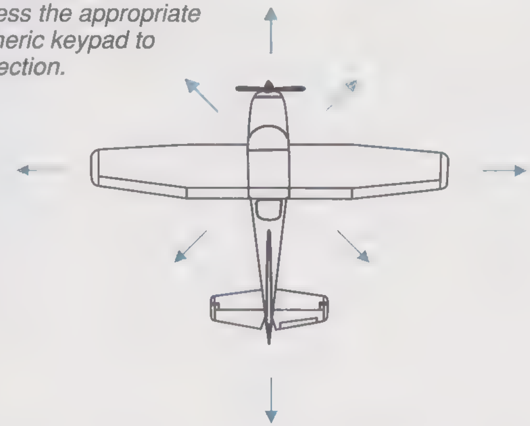
In Cockpit and Spot views, you can look in nine directions. You cannot change the view direction in Tower or Track views.

To choose a view direction with the keyboard

- Hold down the SHIFT key (or SCROLL LOCK), and then press one of the view direction keys, as shown in the following illustration.

Cockpit View Directions

In Cockpit view, hold down the SHIFT key and then press the appropriate keys on the numeric keypad to change view direction.



In Cockpit view, you can also pan up or down. Panning is a smooth and gradual way of changing your view direction to get a more realistic view out the cockpit window.

To pan up or down with the keyboard

1 Press SHIFT+BACKSPACE to pan up gradually.

2 Press SHIFT+ENTER to pan down gradually.

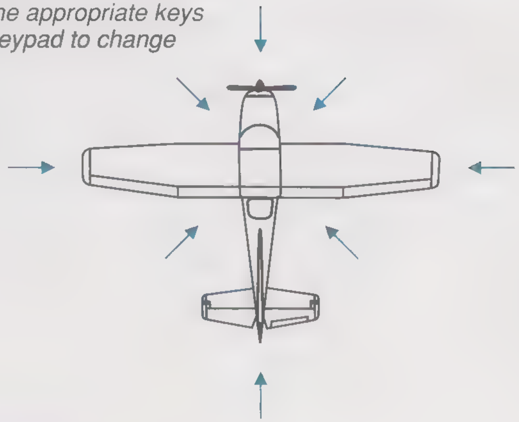
3 Press SCROLL LOCK or the ASTERISK key on the numeric keypad to return to straight-ahead level view.

Setting the Spot Plane

You might want to use Spot view to see how different actions look from outside your aircraft, especially when you're trying out a new flying maneuver. You can adjust the position of the spotter plane as it watches your aircraft either by holding down the SHIFT key while you press the arrow keys or choosing Set Spot Plane from the Views menu.

Spot Plane View Directions

In Spot view, hold down the SHIFT key and then press the appropriate keys on the numeric keypad to change view direction.



Setting spot plane direction using the keyboard is convenient when flying, but using the menu gives you more control and lets you specify items such as spot plane altitude and aerobatic view preferences.

To set the spot plane with the Views menu

1. From the Views menu, choose Set Spot Plane.

   Flight Simulator displays the Set Spot Plane dialog box.

2. In the View box, choose the window where you want to set the spotter plane.

3. In the Distance and Altitude boxes, type the spot plane's distance and altitude from your aircraft.

   Distance is the position you want the spot plane in relation to your aircraft. Spot altitude is the difference in altitude between the spotter plane and your aircraft. A positive value places the spotter at a higher altitude than that of your aircraft. A negative value places the spotter below you. The spotter can never go below ground level.

4. Under Preference, choose the Roll or Loop option.

   Roll causes the spot plane to fly relative to your heading. If you roll, your heading remains the same, and the spotter plane tracks you from one side, letting you watch the complete roll. Loop causes the spot plane to fly relative to your wing. If you loop, your wings stay in the same horizontal plane, and the spotter plane tracks you from one side, letting you watch the complete loop.

5 Under Transition, choose the Slow or Fast option.

A slow setting gradually changes the spot plane to another position. A fast setting causes an abrupt change.

6 In the View Direction box, drag the dot to change the spotter plane view direction.
–or–
Press the arrow keys to move the position of the spotter plane.

For example, if you want the spotter plane to view your aircraft from the left, move the dot until it's even with your left wing.

7 Choose the OK button.

Flight Simulator displays your aircraft from a new perspective.

Zoom Control

View 1 and View 2 zoom factors range from .25 to 511. Map View is always at 1.00, but you can change your view altitude by pressing the PLUS SIGN or MINUS SIGN key for a range from 200 feet to the whole earth view at 160,000 miles (257,440 kilometers).

View distortion at very high or very low magnification can affect your sense of direction and movement.

With zoom control, you can view from any distance or altitude you want. Zoom in so that you are close enough to touch your aircraft or zoom out to get a bird's-eye view of the airport below.

You can zoom in or out with the mouse, the keyboard, or by choosing the View Options command from the Views menu. You can use zoom control in all views—Cockpit, Tower, Track, and Spot. You can also use the zoom controls in all the windows—the two three-dimensional windows and the map window. The zoom control keys affect only the active window.

The zoom indicator on the instrument panel displays the zoom factor of the active window.

To zoom in or out with the mouse

1 Choose a window.

2 Click the zoom indicator on the instrument panel.

Clicking to the left side of the digits decreases the zoom factor; clicking to the right side increases it.

If you press the zoom keys and the magnification does not change, make sure you have selected the view window. Press the OPENING BRACKET ([) key for View 1, the CLOSING BRACKET (]) key for View 2, or the NUMLOCK key for Map View.

To zoom in or out with the keyboard

▶ Press one of the following keys or key combinations.

Keys	Action
+ =	*Zoom in.*
Shift + + =	*Zoom in (fine).*
– -	*Zoom out.*
Shift + – -	*Zoom out (fine).*
← Backspace	*Return to normal field of vision (1.00).*

When landing, taking off, or performing aerobatics, make sure the zoom control is 1.00, which is one-times magnification, normal field of vision.

To zoom in or out with the Views menu

1. From the Views menu, choose View Options.

   Flight Simulator displays the View Options dialog box.
2. Choose a window.
3. Choose the Zoom box, and type the magnification factor you want.
4. Choose the OK button.

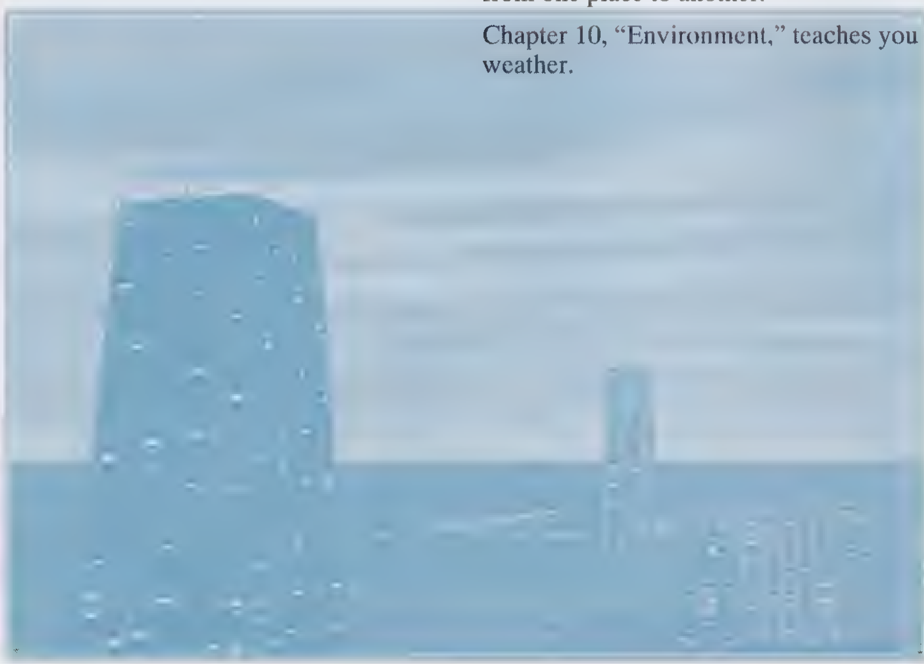
Flight Simulator's World

When you start Flight Simulator, you fly under optimum conditions—clear skies and unlimited visibility. You really put your skills as a pilot to the test, however, when you have to make a landing in unfamiliar surroundings, or fly when the wind is raging and the sky is stormy. These are the challenges that make you a better pilot.

This section teaches you how to change your location, on the ground and in the air, and how to alter the Flight Simulator environment, including time, season, weather, and scenery.

Chapter 9, "Scenery and Location," gives you the opportunity to change the scenery around you, your departure or arrival point, and the latitudinal and longitudinal coordinates that constitute your exact location. You'll also learn how to move quickly from one place to another.

Chapter 10, "Environment," teaches you how to change the time, season, and weather.



Chapter 9 Scenery and Location

For more information on display options that affect the appearance of the Flight Simulator world, see "Display Preferences" on page 11.

This chapter describes the scenery in Flight Simulator and teaches you how to change the way it looks. You'll learn how to travel between different scenery areas and watch the view from your cockpit change as you fly. You'll enhance the world around you by adding stars in the sky and approach lighting at night. You'll also learn to make Flight Simulator's airports as busy and difficult to navigate as any real airport by adding moving traffic both on the ground and in the air.

This chapter also teaches you how to get around in Flight Simulator's world. You can take off or land at the airport of your choice. You can start flying from anywhere on the face of the earth simply by setting your latitude and longitude. You can move around quickly without flying if you want to check out the terrain below, or change the rate of simulation so that you can fly across the Pacific Ocean in the wink of an eye.

Changing the Scenery

For more information on sectionals, see "Reference Books for Pilots of All Levels" on page 189.

Additional scenery disks (with enhanced detail for specific areas) are available from Microsoft and other companies, or you can use Microsoft Aircraft & Scenery Designer version 5.0 or later to create your own scenery areas.

The scenery on your Flight Simulator disks includes more than 100 airports in seven general areas. These areas are based on the sectional maps that pilots use to plan flights.

- Chicago
- Los Angeles
- Munich
- New York
- Paris
- San Francisco
- Seattle

If you fly beyond these areas, you will see synthesized generic scenery that represents the rest of the world.

Scenery Library

With the Flight Simulator Scenery Library command on the Scenery menu, you can choose either new scenery created specifically for Flight Simulator version 5.0 or old scenery areas from Flight Simulator version 4.0.

To choose a scenery area

1. From the Scenery menu, choose Scenery Library.

   Flight Simulator displays the Scenery Library dialog box.

2. From the list, choose the scenery area you want.

   - Choose FS5WORLD to use Flight Simulator 5.0 scenery areas. This option makes all version 5.0 scenery areas available, including any Flight Simulator version 5.0 scenery disks.
   - Choose any Flight Simulator version 4.0 scenery files you want to use.

Flight Simulator automatically switches scenery areas for all version 5.0 scenery.

3. For version 4.0 scenery, choose the Automatic Scenery Area Switching check box if you want Flight Simulator to switch scenery areas automatically as you move from one scenery area to another.

   If you have additional version 4.0 scenery disks loaded on your computer that include locations in your flight path, Flight Simulator automatically switches to the correct area when you reach it.

4. Choose the OK button to return to Flight Simulator and fly in the scenery area of your choice.

Scenery Complexity

You can add stars in the sky and runway approach lighting at night. You can also change earth patterns to add realism to your landscapes. The other way to go is to simplify your view: choose to see the horizon only or to see scenery as wire-frame polygons. The general rule is that the more complex your scenery, the slower Flight Simulator displays images.

To change the complexity of the scenery area

1. From the Scenery menu, choose Scenery Complexity.

   Flight Simulator displays the Scenery Complexity dialog box.

2. Choose the view you want: View 1 or View 2.

The Wire-Frame Polygons option does not affect all scenery objects and is only available in Flight Simulator version 4.0.

3. Choose the type of complexity you want: Stars In The Sky, Approach Lighting, Horizon Only (No Scenery), or Wire-Frame Polygons.

4. If you are using Flight Simulator version 4.0 scenery, under Earth Pattern, choose the texture option you want: Dots, Small Rectangles, or Big Rectangles.

The Earth Pattern option applies only to Flight Simulator version 4.0 scenery.

The Off option displays no texture, Dots shows the ground textured with random dots, and Small Rectangles and Big Rectangles show the ground texture as a series of rectangles across the landscape.

5. Under Image Complexity, choose the density you want: Very Sparse, Sparse, Normal, Dense, or Very Dense.

   Keep in mind that the more visual complexity you add, the slower your screen display will be.

You can also choose the Image Smoothing check box for a smoother display or, for flying at night, choose the Moonlight At Night check box.

6. Choose the OK button to return to Flight Simulator.

Dynamic Scenery

Dynamic scenery includes moving ground traffic, boats, and other aircraft in the sky to make your flights more realistic. Dynamic scenery is available in the San Francisco, Chicago-O'Hare, and Chicago Meigs areas.

You can choose the view window you want and the type and amount of dynamic scenery.

To display dynamic scenery

If you want to display dynamic scenery whenever you start Flight Simulator, choose Preferences from the Options menu, and then choose the Dynamic Scenery At Startup check box.

1. From the Scenery menu, choose Dynamic Scenery.

   Flight Simulator displays the Dynamic Scenery dialog box.

2. Choose the view you want: View 1 or View 2.
3. Choose the type of dynamic scenery you want: Air Traffic, Aircraft Ground Traffic, Airport Service Traffic, or Traffic Outside Airports.
4. From the Scenery Frequency list, choose the Very Sparse, Sparse, Normal, Dense, or Very Dense option.

   Keep in mind that the more scenery density you add, the slower your screen display will be.

5. Choose the OK button to return to Flight Simulator with the new dynamic scenery options.

Changing Your Location

To meet the increasing demands of Flight Simulator pilots with international interests, Flight Simulator's world now has the same wide and expansive dimensions as the entire real world, with a true latitude and longitude system.

Additional scenery disks are available from Microsoft and other companies, or you can use Microsoft Aircraft & Scenery Designer version 5.0 to create your own scenery areas.

Flight Simulator is a real-time simulator. Flying between distant points such as Seattle's Boeing Field and New York's Kennedy International Airport takes as much time as it would in a real aircraft. The Cessna Skylane RG aircraft holds approximately 88 U.S. gallons or 333 liters of fuel. Under optimal conditions, this would take you almost 1500 miles (2414 kilometers) from your takeoff point. You would run out of fuel in about 5.5 hours.

Remember, your aircraft will never run out of fuel unless you choose Realism And Reliability from the Sim menu, and then choose the Engine Stops When Out Of Fuel check box.

Because there are no airports outside Flight Simulator's designated scenery areas, you cannot fly the Cessna across the United States without running out of fuel, unless you have additional scenery disks. However, you can move from one area to another by using any of four methods: choosing an airport, setting destination coordinates, slewing, or changing the rate of simulation.

Changing to Another Airport

You can only use the Airports command with Flight Simulator version 5.0 scenery (not with version 4.0 scenery).

You can change your location at any time to one of Flight Simulator's many airports, using the Airports command on the World menu. When you switch to another airport, you are immediately transported to the new location. It's advisable to change airports while your aircraft is on the ground. If you are in flight when you change locations, you may crash at the new location because of flight variables, such as altitude or airspeed.

To choose an airport

1. From the World menu, choose Airports.

   Flight Simulator displays the Airports dialog box.

2. From the list, choose the scenery area you want for your airport.

   For example, choose Seattle for Seattle-area airports.

3. Choose an airport from the list.

   For example, choose Everett—Paine Field—Runway 16R.

4. Choose the OK button.

   You are now on the runway at the airport of your choice.

Setting the Exact Location

A faster way to move from one area to another, especially if you know the exact location, is to set destination coordinates manually. For example, if you want to begin your flight at Seattle-Tacoma Airport in Seattle and fly to Snohomish County

Airport (Paine Field) in Everett, Washington, you can set the coordinates for the airfield in Everett. For exact coordinates, refer to the sectionals in Appendix B, "Sectionals, Directories, and Runway Maps," on page 211. They list the coordinates and the elevations of all Flight Simulator airports.

To set coordinates

1. From the World menu, choose Set Exact Location.

   Flight Simulator displays the Set Exact Location dialog box.

If you enter 0 as the value for altitude in the Altitude box, your aircraft starts out at the airport's field elevation (AGL).

2. In the Set Location Of box, choose Aircraft or Control Tower.
3. Choose Set Location With Latitude/Longitude for Flight Simulator version 5.0 scenery.
   –or–
   Choose Set Location With X/Z Coordinates for Flight Simulator version 4.0 scenery.

   Flight Simulator 5.0 uses the real-world latitude and longitude system, while Flight Simulator 4.0 uses an X/Z (or East/North) coordinate system. When you want to set your exact location, Flight Simulator automatically chooses the correct coordinate system based on the scenery files that you are currently using.

If you choose Preferences from the Options menu, choose the Country button, and then, in the Latitude box, choose Northern, you can omit the N when you type a northern latitude.

4. In the appropriate boxes, type the coordinates for your aircraft or the control tower, and then type the airport's altitude.

   For example, to position your aircraft on the runway at Paine Field in Everett, Washington, make sure to choose the Set Location With Latitude/Longitude option, and then type **N047 54** in the North/South Latitude box, **W122 17** in the East/West Longitude box, and **606** in the Altitude (Ft) box.

Runway numbers refer to compass headings. Runway 16 faces 160 degrees, Runway 34 faces 340 degrees, and so on.

5. In the Heading box, type the compass heading you need to set your aircraft on the runway.

   For example, if you want to use runway 34, type **340.00**

6. Choose the Set Tower View (From Aircraft Location) button if you want to see your aircraft from Tower view, even if your aircraft is far from an airport with a control tower.

   You can also create a control tower view location manually by slewing your aircraft to the position at which you want the tower, and then choosing Control Tower in the Set Location Of box, and typing in the latitude, longitude, and altitude.

7 Choose the OK button.

If you want to cancel changes and reset to the original coordinates, choose the Cancel button.

Slewing

Slewing lets you move slowly or rapidly from one point to another while viewing the scenery along the way. There are two types of slewing. The first involves changing your aircraft's pitch, bank, or heading while the aircraft remains at one location. For example, if you want to quickly reverse your direction, you can slew 180 degrees to the opposite heading. The second type of slewing involves changing your aircraft's location or altitude. For example, you can slew across country or to the other side of an airport.

You can also press the Y key to turn the Slew command on or off.

The slewing actions are Pitch, Bank, Heading, Altitude, and Movement. You must turn on the Slew command on the World menu before you can slew with the mouse, keyboard, or joystick.

To change your position by slewing

Press the Z key repeatedly to view different coordinate readouts.

1 From the World menu, choose Slew.

The coordinates of your current location are displayed in the upper-left corner of the view window, and the word "Slew" is displayed in the status indicator. A check mark next to the Slew command indicates that it is turned on. You can also press the Y key to turn the Slew command on or off.

For more information on keyboard slewing controls, see Appendix D, "Keyboard Summary," on page 239.

2 Use the mouse, keyboard, or joystick to change your position.

Try slewing with the mouse, keyboard, or joystick, using the following illustration on slew controls.

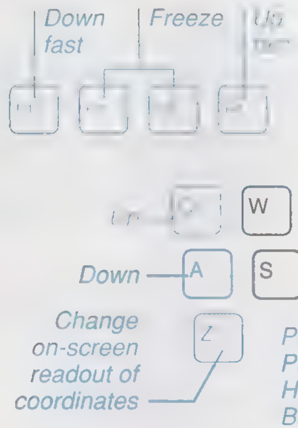
3 From the World menu, choose Slew again or press the Y key to turn off slewing.

If you were on the ground and stationary when you began slewing and you slewed to a high altitude, you will drop like a rock when you turn off the slewing command. Once you gain airspeed, you can roll out of the dive. This can be a lot of fun.

Slewing with the Keyboard

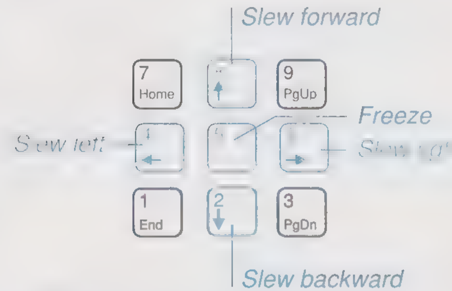
To use the keyboard slewing controls, you must first press the Y key or choose the Slew command from the World menu. These slewing commands are for keyboards with function keys across the top. For additional keyboard information, see Appendix D, "Keyboard Summary."

Altitude (keyboard)

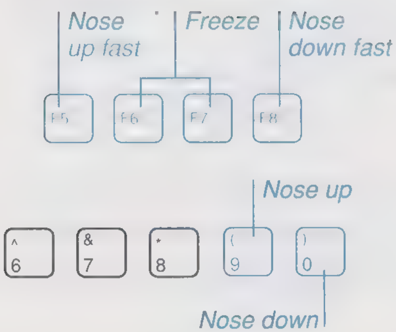


Press the SPACEBAR to reset orientation.
Pitch: straight ahead
Heading: north
Bank: 0°

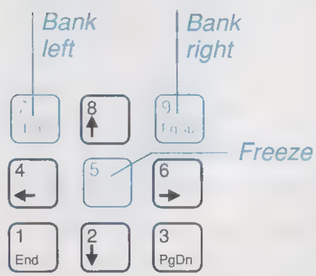
Movement (keypad)



Pitch (keyboard)



Bank (keypad)



Heading (keypad)

Slewing with the Mouse and Joystick

Changing Simulation Speed

You can change the rate of simulation in Flight Simulator, but remember that when you do, you change not only the speed at which your aircraft travels, but you slow down or speed up the world around you as well. If there is other airport traffic around you or clouds in the sky, they are affected when you change the simulation speed.

To change simulation speed on the instrument panel

▶ On the instrument panel, click to the left of the numbers in the rate of simulation indicator to decrease the speed of simulation; click to the right of the numbers to increase the speed of simulation.

The normal simulation rate for Flight Simulator is 1.0. Choosing a lower rate (for example, .50) slows down the simulation. Choosing a higher rate (for example, 4.0) speeds up the simulation.

To change simulation speed with the Sim menu

The normal simulation rate for Flight Simulator is 1X. Choosing a lower rate (for example, 1/2X) slows down the simulation. Choosing a higher rate (for example, 4X) speeds up the simulation.

1. From the Sim menu, choose Simulation Speed.

   Flight Simulator displays the Simulation Speed dialog box.
2. In the Simulation Rate box, choose the speed you want.
3. Choose the OK button to return to Flight Simulator.

Chapter 10 Environment

When you start Flight Simulator, you fly under optimum conditions. However, learning techniques for flying in bad weather, under heavy cloud cover, or for landing in unfamiliar surroundings at night, can provide the challenges that make you a better pilot. In Flight Simulator, you can practice flying in every imaginable climate. Fly on a warm, sunny summer day or on a clear winter night when the sky is filled with stars. Fly through a windy autumn afternoon or during a spring thunderstorm. A skilled pilot must be able to handle the controls in all kinds of conditions.

This chapter describes how to alter the Flight Simulator environment, including time, season, and weather. It also explains how to add different weather areas so that you can take off under clear skies, pass through a storm, and land under high clouds. All the options described in this chapter are available on the World menu.

Changing the Time and Season

Flight Simulator automatically makes flight conditions correspond to the time of day set by your computer. When you choose Preferences from the Options menu, and then, under Time At Startup, choose Use System Time, transition times for day, night, dawn, and dusk are based on the latitude and longitude of your aircraft and the earth's inclination toward the sun, as well as the season and the date on your computer. At high latitudes, you may experience 24-hour darkness in the middle of the winter. Ground shadows accurately reflect the sun's angle at all latitudes and times.

If you choose Preferences from the Options menu, and then, under Time At Startup, choose the Use Situation Time option, Flight Simulator saves the instrument-panel time with each particular situation.

In Flight Simulator, you can manually change the time and season to suit your whims or needs. For example, even though the real time (as set by your computer) is nine o'clock in the morning and there's frost on your windowpane, you might want to try flying on a moonlit summer night. Go ahead—create your own reality!

To change the time and season

1. From the World menu, choose Set Time And Season.

   Flight Simulator displays the Set Time And Season dialog box.

2. In the Set Season box, choose Winter, Spring, Summer, or Autumn.

3. In the Set Time Of Day box, choose Dawn, Day, Dusk, or Night, and then choose the OK button.
   –or–
   Choose the Set Exact Time option, and then type the time you want.

   Choose the Reset Seconds To Zero option to reset the seconds to zero.
4. Choose the OK button.

To change the time on the instrument panel

Clock —
Rate of simulation —

1. On the instrument-panel clock, click the left side of the hour digits to decrease the hours, or click the right side of the hour digits to increase the hours.
2. Click the left side of the minutes digits to decrease the minutes, or click the right side of the minutes digits to increase the minutes.
3. Click the seconds to reset the seconds digits to zero.

Adding Weather Areas

In Flight Simulator, you use the Weather command to add weather areas. For example, you can use the Global weather area that comes with Flight Simulator as an en-route weather area, and add both a departure and a destination weather area so that you can take off under cloudy cover, fly into a thunderstorm, and escape into windy but clear skies on the other side.

For more information on manually setting cloud, wind, and temperature layers, or barometric pressure, see "Changing the Weather" on page 87.

Flight Simulator makes weather simple for new pilots. You can choose the Automatic Weather Generation option in the Add Weather Area dialog box, and Flight Simulator randomly assigns clouds and winds for your weather area (or areas). Or, if you are more experienced in the meteorological aspects of flight, you can set your own barometric pressure, as well as cloud, wind, and temperature layers.

Flight Simulator comes with the Global weather area. The Global weather area applies to the whole world, but does not include the one or two local weather areas that you can add and edit at any time.

To add a weather area

1. From the World menu, choose Weather.

   Flight Simulator displays the Weather dialog box. Note that in the Weather Area box, the only area listed is the Global weather area. Flight Simulator offers this generic weather area when you first start the program. It covers the whole world.

You can choose the Edit Area button to modify, the Delete Area button to delete, or the Copy Area button to copy any already existing weather area except the Global weather area. You cannot edit or delete the Global weather area.

For more information on copying a weather area, see "Copying a Weather Area or Category" on page 91.

2 Choose the Add Area button.

Flight Simulator displays the Add Weather Area dialog box.

3 In the Area Name box, type a name for your weather area.

For example, type **Coastal Front**

4 Under Latitude and Longitude, type the beginning and ending coordinates for the length of the front.

For example, if you want to create a front that moves in from the Pacific Ocean toward Seattle, Washington:

- In the Beginning Latitude box, type **N048**
- In the Beginning Longitude box, type **E125**
- In the Ending Latitude box, type **N040**
- In the Ending Longitude box, type **E125**

5 In the Width box, type a width for your weather front.

For example, type **10**

6 In the Transition box, type a number for the distance between areas.

For example, if you want to fly from overcast to sunny skies within a short distance, type a low number, such as **5**

7 In the Course box, type a number (in degrees) for the course of your weather front.

For example, if you want the front to move from west to east, type **090**

8 In the Speed box, type a number (in knots) for the speed of your weather front.

For more information on manually setting cloud, wind, and temperature layers, or barometric pressure, see "Changing the Weather" on page 87.

9 If you want Flight Simulator to randomly define the weather for your weather area, choose the Automatic Weather Generation option, and then choose the Clouds and Winds check boxes, depending on the kinds of conditions you want.

10 Choose the OK button.

Flight Simulator displays the Weather dialog box. Look in the Weather Area box for your new weather area—it's on the list.

11 Choose the OK button again to save your changes and return to Flight Simulator.

Now that you've added a weather area you can make it more real by creating cloud layers, winds, high or low temperature layers, and barometric pressure.

Changing the Weather

Flight Simulator also provides random weather conditions when you choose Weather from the World menu, choose the Add Area button, and then choose the Automatic Weather Generation option.

Weather is probably the most complex flight factor that a pilot encounters. When you first start Flight Simulator, the ceiling is high and the visibility good. When you choose the Preferences command from the Options menu, and then choose the Weather Generation At Startup check box, Flight Simulator provides random weather conditions as you fly.

Flight Simulator also includes a sophisticated weather system that lets you alter the airways to test your aeronautical acumen. The Weather command on the World menu lets you modify the following four meteorological elements: cloud formations, wind changes, temperature layers, and barometric pressure.

Creating Cloud Layers

In the world of flying, altitude is universally measured in feet, regardless of the units of measure commonly used in a country.

In Flight Simulator, cloud-layer altitudes are measured in feet above mean sea level (MSL), not feet above ground level (AGL). When you set the base value for clouds, be sure to specify an altitude that is above the altitude of your runway. For example, Chicago Meigs Field is 593 feet MSL, so you should set the cloud base at 700 feet or higher. Flight Simulator displays the altitude (MSL) of your current location at the top of the view window when you press the Y key (to turn on the Slew command).

You can set the type of cloud, its base, its height (or tops), the amount of coverage, and deviation. Coverage can range from clear to overcast. Deviation is used to vary cloud height and add realism. When you enter a deviation value, Flight Simulator increases the cloud tops value and decreases the cloud base value by a random number between zero and the deviation value you entered.

The amount and type of cloud complexity may affect simulation display rate. For information, see "Video" on page 197.

For example, you may have entered a base value of 3000 and a tops value of 4000. If you then enter a deviation value of 500, the tops value would be increased by a random value between 0 and 500, and the base value would be decreased by a random number between 0 and 500.

To create cloud layers

1 From the World menu, choose Weather.

   Flight Simulator displays the Weather dialog box.

For more information on adding a new weather area, see "Adding Weather Areas" on page 85.

2 In the Weather Area box, choose the area in which you want cloud layers.

   If you don't change the weather area, Flight Simulator adds any cloud layers you create to the Global weather area.

3 Choose the Clouds button.

4 Under the Cloud Layers box, choose the Create button.

   Flight Simulator displays the Create Cloud Layer dialog box.

In Flight Simulator, you can create two cloud layers and one thunderstorm layer.

5 In the Type box, choose Clouds or Thunderstorm.

6 In the Base and Tops boxes, type a number for the base and top of the cloud layer.

7 In the Coverage box, choose a degree of coverage.

   - With clouds, the degree of coverage can range from clear to overcast. Scattered and broken cloud layers are followed by a fractional number that indicates the amount of sky covered by scattered or broken cloud layers.
   - With thunderstorms, the degree of coverage can range from widely scattered to dense.

8 In the Deviation box, type a number if you want to make the appearance and frequency of clouds random (between zero and the number you type).

9 Choose the OK button.

   Flight Simulator displays the Weather dialog box, and lists the cloud layer you just created in the Cloud Layers box.

10 Choose the OK button again to save your changes and return to Flight Simulator.

You can choose the Edit button to modify an already existing cloud layer or the Delete button to delete an already existing cloud layer.

For more information on copying a weather category, see "Copying a Weather Area or Category" on page 91.

Creating Wind Layers

In Flight Simulator, you can simulate realistic flying conditions by setting winds at different levels.

Winds aloft have six options: type, base, tops, speed, direction, and turbulence. They require a top and base altitude in feet or meters (MSL), as well as a speed, direction relative to true north (not magnetic north), and a degree of turbulence.

Surface winds have five options: type, depth, speed, direction, and turbulence. They are encountered from ground level up to the altitude (AGL) you specify in the Depth box. Surface-wind direction is magnetic.

To create wind layers

For more information on adding a new weather area, see "Adding Weather Areas" on page 85.

In Flight Simulator, you can create three winds aloft layers and one surface winds layer.

In the world of flying, altitude is universally measured in feet, regardless of the units of measure commonly used in a country.

1. From the World menu, choose Weather.

   Flight Simulator displays the Weather dialog box.

2. In the Weather Area box, choose the area in which you want wind layers.

   If you don't change the weather area, Flight Simulator adds any wind layers you create to the Global weather area.

3. Choose the Winds button.
4. Under the Wind Layers box, choose the Create button.

   Flight Simulator displays the Create Wind Layer dialog box.

5. Choose either the Wind Aloft option or the Surface Wind option, depending on the kind of wind layer you want to create.

   Winds aloft require a base and top altitude (MSL), with direction relative to true north. Surface winds are encountered from ground level up to the altitude (AGL) that you specify in the Depth box, with magnetic direction.

6. In the Type box, choose the kind of winds you want—steady or gusty.
7. In the Base and Tops boxes, type a number for the base and top of the wind layer.
8. In the Speed box, type a number for wind speed.
9. In the Direction box, type a number for wind direction.

   For example, if you want winds to move from south to north, type **180**; if you want winds to move from north to south, type **000**

10. Drag the slider control to adjust turbulence, if desired.

    The Turbulence option controls irregular motion, such as up-and-down movements of air currents.

11. Choose the OK button.

You can choose the Edit button to modify an already existing wind layer or the Delete button to delete an already existing wind layer.

For more information on copying a weather category, see "Copying a Weather Area or Category" on page 91.

Flight Simulator displays the Weather dialog box, and lists the wind layer you just created in the Wind Layers box.

12 Choose the OK button again to save your changes and return to Flight Simulator.

Creating Temperature Layers

A major factor affecting the stability of air is its temperature. The uneven heating of the earth's surface causes variations in air temperature and density. In Flight Simulator, you can create temperature layers and learn about aircraft performance in different air temperatures.

To create temperature layers

1. From the World menu, choose Weather.

   Flight Simulator displays the Weather dialog box.

For more information on adding a new weather area, see "Adding Weather Areas" on page 85.

2. In the Weather Area box, choose the area in which you want temperature layers.

   If you don't change the weather area, Flight Simulator adds any temperature layers you create to the Global weather area.

In Flight Simulator, you can create four temperature layers.

3. Choose the Temp button.
4. Under the Temperature Layers box, choose the Create button.

   Flight Simulator displays the Create Temperature Layer dialog box.

You can choose the Edit button to modify an already existing temperature layer or the Delete button to delete an already existing temperature layer.

You can see temperature layers in action by flying or slewing to various altitudes and watching the outside air temperature gauge on the instrument panel.

5. In the Temperature Altitude box, type an altitude for the temperature layer.

   This is the temperature at this altitude.
6. In the Daytime Temperature box, type a temperature.
7. Choose the OK button.

   Flight Simulator displays the Weather dialog box, and lists the temperature layer you just created in the Temperature Layers box.
8. To add a realistic variance between daytime and evening temperatures, choose the Day/Night check box, and then, in the Variation Range box, type a variation range.
9. Choose the OK button to save your changes and return to Flight Simulator.

Changing the Barometric Pressure

Differences in weather systems (high and low pressure areas) result in changes in atmospheric pressure. Changes in pressure create motion in the form of currents and winds. Barometric pressure is recorded in inches of mercury or in millibars at sea level. One inch of mercury is equivalent to approximately 34 millibars. The normal atmospheric pressure at sea level (29.92), expressed in millibars, is 1013.2, or roughly 1000 millibars.

To change the barometric pressure

1. From the World menu, choose Weather.

   Flight Simulator displays the Weather dialog box.

2. In the Weather Area box, choose the area in which you want to change the barometric pressure.

   If you don't change the weather area, Flight Simulator adds any changes in barometric pressure to the Global weather area.

3. Choose the Baro button.
4. In the Barometric Pressure box, type the pressure you want in inches of mercury or millibars.
5. Choose the Drift check box if you want Flight Simulator to add random barometric drift.
6. Choose the OK button to save your changes and return to Flight Simulator.

For more information on adding a new weather area, see "Adding Weather Areas" on page 85.

Copying a Weather Area or Category

Once you know how to add a weather area and change the weather within that area, you can quickly and easily diversify the kinds of weather you fly in. All you have to do is copy your weather area, give it a new name, and modify it. Pretty soon you'll have a whole library of weather scenarios to choose from.

To copy a weather area

1. From the World menu, choose Weather.

   Flight Simulator displays the Weather dialog box.

2. In the Weather Area box, choose the area you want to copy.

You can choose the Edit Area button to edit or the Delete Area button to delete any already existing weather area except the Global weather area.

You cannot change the latitude or longitude of the Global weather area.

3 Choose the Copy Area button.

Flight Simulator displays the Copy Weather Area dialog box.

4 Next to Copy From, make sure the weather area you want to copy is displayed.

5 In the Copy To box, choose the destination weather area.

6 Choose the OK button.

Flight Simulator copies all the components of one weather area to the weather area of your choice, and then displays the Weather dialog box.

7 Choose the OK button again to save your changes and return to Flight Simulator.

You can also copy a weather category. For example, you can copy wind layers from a dry, windy weather area to a weather area with lots of clouds but no winds. Does that sound like a thunderstorm brewing? Fasten your seat belt and find out.

To copy a weather category

1 From the World menu, choose Weather.

Flight Simulator displays the Weather dialog box.

2 Make sure that the category you want to copy is displayed.

For example, if you want to copy wind layers, first choose the Winds button.

3 Choose the Copy Category button.

Flight Simulator displays the Copy Category dialog box.

4 Next to Copy From, make sure the weather area you want to copy from is displayed.

5 In the Copy To box, choose the destination weather area.

6 Choose the OK button.

Flight Simulator copies all the components of the specified weather category to the weather area of your choice, and then displays the Weather dialog box.

7 Choose the OK button again to save your changes and return to Flight Simulator.

Now that you know how to create a whole world of weather, get out there and try flying in it!

Flight School

Welcome to Microsoft Flight Simulator Flight School. If you're a novice pilot, this section teaches you the basics of flight, as well as more advanced techniques.

If you're a veteran pilot just taking a refresher course, you can concentrate on navigation, flight analysis, course tracking, and the logbook. These features help you polish your skills and keep track of your flying time.

Chapter 11, "Ground School," teaches you the basics of flight physics, attitude flying, and the rules of flight.

Chapter 12, "Basic Flight Training," offers hands-on practice of fundamental flight techniques in 10 flying lessons.

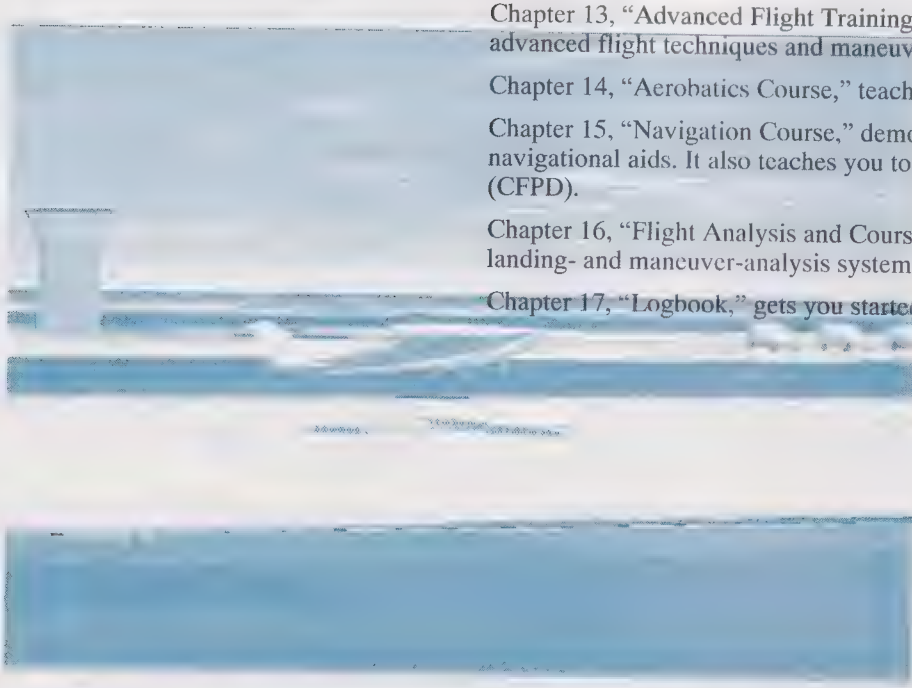
Chapter 13, "Advanced Flight Training," increases your expertise with more advanced flight techniques and maneuvers.

Chapter 14, "Aerobatics Course," teaches common aerobatic maneuvers.

Chapter 15, "Navigation Course," demonstrates radio navigation using radio navigational aids. It also teaches you to use the Command Flight Path Display (CFPD).

Chapter 16, "Flight Analysis and Course Tracking," explains Flight Simulator's landing- and maneuver-analysis system and the course-tracking system.

Chapter 17, "Logbook," gets you started keeping your logbook up to date.



Chapter 11 Ground School

The *Flight Training Handbook,* published by the Federal Aviation Administration (FAA), is an important reference for both novice and veteran pilots. The handbook includes information on such topics as the basics of flight, engines and aircraft, controls and maneuvers, traffic patterns, taking off, landing, and emergency situations. A pilot must also understand aviation weather, radio navigation, instrument flying, operating in controlled airspace and traffic areas, and Federal Aviation Regulations (FAR).

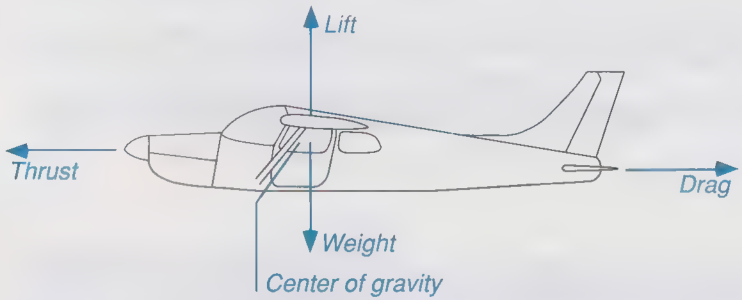
For more information about ground school training materials, see "Flight Training Books" on page 188.

This chapter briefly covers a few of the important points taught in the first day or two of ground school. All the information is from flight-training material. When you actually start flying, however, there is no substitute for a course that treats these topics in depth and puts you through 50 or more hours of flight time with an instructor.

Balance of Forces

There are four components that must be balanced when flying an airplane: lift, drag, thrust, and weight. These four forces interact under the pilot's control.

Balance of Forces



Lift

If you need a definition or explanation of a term, check the Glossary on page 251.

Lift is produced by two natural forces: pressure and deflection. The airflow over the curved top of the wing is faster and has less pressure than the airflow along the underside of the wing, which is deflected downward, and reacts by pushing (lifting)

the wing upward. Lift is influenced by your speed and your angle of attack to the oncoming air—how far you pitch up and raise the aircraft's nose. The more you pull back on the control yoke and gain speed, the greater your angle of attack, thus creating a greater deflection of air, and producing more lift.

If you increase the angle of attack too much, however, the wing stalls. A stall is caused by the separation of airflow from the wing's upper surface, which results in a rapid decrease in lift. All you have to do to recover from a stall is to restore the smooth airflow. The only way to do this is to decrease the angle of attack by applying down elevator, and then applying full throttle.

Drag

Drag is the resistance created by air particles striking and flowing around the aircraft as it moves through the air. Drag pulls the aircraft back and balances out the thrust from the engine. As your speed increases, drag increases proportionally to the square of the velocity. For example, if you go twice as fast, you have four times as much drag.

Thrust

Thrust moves the aircraft forward through the air. The propeller receives its power directly from the engine and displaces a large mass of air backward. It is this rearward displacement that develops the forward thrust that carries the aircraft through the air. The aircraft continues to accelerate only while the force of thrust exceeds the force of drag. When drag again equals thrust, the aircraft ceases to accelerate and maintains a constant airspeed.

Horsepower is a measure of force over distance during a defined period of time. When you double your speed, you square your drag (which takes four times as much horsepower to balance) and double your distance covered over time (which takes twice again as much horsepower). Horsepower requirements increase as a function of velocity cubed. It takes eight times as much horsepower to go twice as fast.

Stability, Weight, and Balance

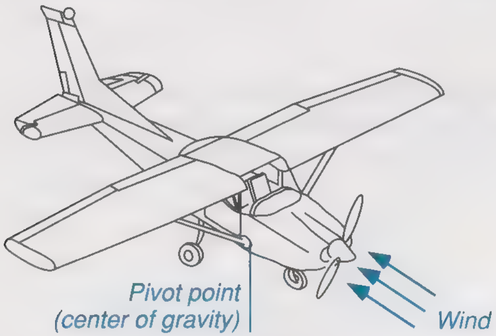
Most aircraft have two sets of wings—one set in front and a small set in back for stability.

An aircraft must fly straight and smoothly through the air for its wings to work properly. An important influencing factor is the weathervane effect—the tendency to pivot around a pivot point until the airfoils are in back of the pivot point in

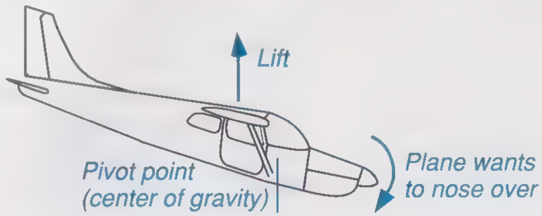
relation to the oncoming wind. To make an aircraft stable, you must put the wings' center of lift behind the aircraft's center of gravity.

At the same time, putting the wings' center of lift behind the aircraft's center of gravity makes an aircraft want to nose over, or pitch forward. To prevent this, a small wing, or horizontal stabilizer, can be added to the back of the aircraft to push the tail down and balance the forces. Because this wing is behind the aircraft's center of gravity, it also helps keep the aircraft from pivoting.

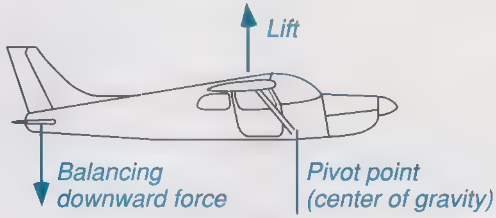
Aircraft Stability



Wings behind the center of gravity cause the aircraft to weathervane into the wind and point forward, instead of flipping around and pointing backward.



The aircraft's lift behind the center of gravity tends to make it nose over.



The small wing, or horizontal stabilizer, at the back of the aircraft pushes the tail down and balances the forces.

When you go on a trip, especially a long cross-country flight with friends and a lot of baggage, it is important to load your aircraft carefully. If you put too much weight in the rear and move the center of gravity behind your center of lift, your aircraft is no longer stable.

For more information about aircraft loading, and weight and balance diagrams, see the pilot's operating handbook (POH) for your aircraft or consult "Flight Training Books" on page 188.

Attitude Flying

An important early lesson for all pilots is attitude flying. The objective of attitude flying is for you to keep your aircraft stable and on course by using the controls, instruments, and outside references for indications of the aircraft's orientation (notably pitch and bank) to the world around it.

For more information on pitch control and bank or roll control, see "Primary Flight Controls" on page 53.

Aircraft control has three components:

Pitch control Using the elevator to raise or lower the nose in relation to the horizon.

Bank or roll control Using the ailerons to control the desired bank angle in relation to the horizon.

Power Using engine speed to establish or maintain desired airspeeds in coordination with attitude changes.

You use the following visual references for aircraft control:

- Aircraft's nose (or axis indicator in Flight Simulator) to show pitch attitude and flight direction
- Aircraft's wingtips to show pitch attitude and bank
- Cockpit view to show angle of pitch and bank in relation to the horizon

Flight instruments are explained in "Primary Flight Controls" on page 53, and "Secondary Flight Controls" on page 61.

You use the following flight instruments as instrument references for aircraft control:

- Attitude indicator to show pitch and bank
- Heading indicator to show direction of flight
- Altimeter to show altitude
- Vertical speed indicator to show rate of climb or descent
- Airspeed indicator to show airspeed

The lessons in Chapter 12, "Basic Flight Training," demonstrate how to use aircraft controls and visual flight rules (VFR) to attain the proper attitude in relation to the horizon. It is important to scan the instrument panel and check all reference points frequently.

Information Scan

With all the flight instruments and visual cues used in flying, it's a good idea to develop a systematic way of scanning your instruments and looking out your

windows periodically. Dividing your attention while you are flying is extremely important for safety and stability in the air.

To scan while in the cockpit

For more information on changing view direction, see "View Controls" on page 66.

Begin your scan out the front of the cockpit, and then follow this sequence:

1. Look out the right window, and then out the front of the aircraft again.
2. Look out the left window, and then out the front of the aircraft again.
3. Check the six primary flight instruments on the instrument panel for airspeed, attitude, altitude, rate of turn, heading, and rate of climb or descent, and then move your gaze back out the front windshield.

Every 30 seconds or so, when you look down at the instrument panel, look at the engine gauges (fuel, oil, tachometer, and so on) to check their status.

The visual scan out the cockpit windows lets you look for air traffic—something that is very important in today's crowded skies.

VFR and IFR Weather Requirements

For more information about reading materials, see "Reference Books for Pilots of All Levels" on page 189.

Before taking off, you must make sure that you are complying with the visibility and instrument requirements for the area in which you are flying. These requirements are in the *Airman's Information Manual (AIM)* and *Federal Aviation Regulations (FAR)*. Make sure you have the latest version of these manuals, because the requirements are updated periodically.

For the lessons in Chapter 12, you will fly in uncontrolled airspace and under VFR conditions. Flight Simulator's weather for the flight lessons meets all basic VFR weather minimums; as long as you stay 500 feet below or 1000 feet above, and 2000 feet horizontally away from any clouds, you are within VFR minimums.

FAR Part 91.155 includes the following table, which lists basic VFR weather minimums between sunrise and sunset.

Altitude	Uncontrolled Airspace: Flight visibility	Uncontrolled Airspace: Distance from clouds	Controlled Airspace: **Flight visibility	Controlled Airspace: **Distance from clouds
1200' or less above the surface, regardless of MSL altitude	*1 statute mile	Clear of clouds	3 statute miles	500' below, 1000' above, 2000' horizontal
More than 1200' above the surface, but less than 10,000' MSL	1 statute mile	500' below, 1000' above, 2000' horizontal	3 statute miles	500' below, 1000' above, 2000' horizontal
More than 1200' above the surface, and at or above 10,000' MSL	5 statute miles	1000' below, 1000' above, 1 statute mile horizontal	5 statute miles	1000' below, 1000' above, 1 statute mile horizontal

*Helicopters may operate with less than 1 mile visibility, outside controlled airspace at 1200 feet or less above the surface, provided they are operated at a speed that allows the pilot adequate opportunity to see any air traffic or obstructions in time to avoid collisions.

** In addition, when operating within a control zone beneath a ceiling, the ceiling must not be less than 1000 feet. If the pilot intends to land or take off or enter a traffic pattern within a control zone, the ground visibility must be at least 3 miles at that airport. If the ground visibility is not reported at the airport, 3 miles flight visibility is required.

Cruising Altitudes

FAR Part 91.159 outlines designated VFR flight level altitudes, including details and exceptions. FAR Part 91.179 outlines designated IFR flight level altitudes.

When you fly cross-country, or fly any nonmaneuver situation, you should fly at designated flight levels. VFR air traffic going east (0 to 179 degrees magnetic) flies at odd thousand feet mean sea level (MSL) plus 500 feet (3500, 5500, 7500, for example), and traffic going west (180 to 359 degrees magnetic) flies at even thousand feet MSL plus 500 feet (4500, 6500, 8500, for example). Instrument flight rule (IFR) traffic flies at odd thousands east and even thousands west (not plus 500 feet).

When the weather is very bad, you will have to fly using instruments. IFR requirements are not nearly as severe as VFR requirements, and flying through clouds is legal, but you must first pass a written test and log in the appropriate flight instruction and skills for an instrument rating. Flight-plan filing and traffic-control requirements are much more severe under instrument flight rule.

Chapter 12 Basic Flight Training

The lessons in this chapter lead you through common flight procedures and maneuvers. You can follow a computerized instructor through each maneuver, or you can fly the maneuver yourself with feedback from the instructor. These lessons familiarize you with the basics of flying and provide a good foundation for future flights.

For a bibliography to help you increase your knowledge of flying, see "Flight Training Books" on page 188.

The explanations that accompany the lessons are excerpts from the *Flight Training Handbook* AC 61-21A, published by the U.S. Department of Transportation, FAA Flight Standards Service. The official handbook covers these topics in much more detail.

Using Flight Instruction

If you just want to practice, choose Quick Practice from the Options menu, and then choose a practice session.

You'll get the most from flight instruction in Flight Simulator if you begin by reading the first lesson in this chapter. Next, choose Flight Instruction from the Options menu, and choose Lesson 1 from the Basic Lesson Category. Let the instructor demonstrate the lesson, and then try it yourself.

When you choose Instructor Control, the instructor flies the lesson and offers comments and tips in the message box. Student Control begins automatically following the instructor's demonstration. You are encouraged to fly on your own and receive feedback afterward.

Read about each lesson in this chapter to get an overview first, and then choose the lesson you want or run them in sequential order.

To start flight instruction

1. From the Options menu, choose Flight Instruction.

   Flight Simulator displays the Flight Instruction dialog box.

2. Choose the Instructor Control option if you first want a demonstration of the lesson from the instructor. Choose the Student Control option if you're ready to fly the lesson yourself.

3. Choose the Lessons In Sequence check box if you want to go through the lessons one after another.

   If you do not choose this check box, you must choose each lesson.

4 In the Lesson Category box, choose Basic, Advanced, or Aerobatic.

5 Choose a lesson from the list, and then choose the OK button.

To change from Instructor Control to Student Control

▶ Press the ESC key at any time to stop the instructor's demo and change to Student Control.

To stop a lesson and start a new one

To stop a lesson, first change from Instructor Control to Student Control.

1 From the Options menu, choose Flight Instruction.

Flight Simulator displays the Flight Instruction dialog box.

2 Choose another lesson from the list, and then choose the OK button.

To end flight instruction

1 From the Options menu, choose Flight Instruction.

Flight Simulator displays the Flight Instruction dialog box.

2 Choose the End Lesson button.

You can do this at any time during a lesson. Flight Simulator stops lesson sequencing and returns you to the startup situation.

Ground Operations

To choose a lesson, see "Using Flight Instruction" earlier in this chapter.

The first step before taking to the air is learning how to move around the airport on the ground. Once you know how to taxi slowly to the runway keeping control of your aircraft, flying is the next step.

Lesson 1. Taxiing

This lesson teaches you to taxi. You will roll down a taxiway, stop at the hold line before the runway, and perform a final check before takeoff.

Basic Flight Maneuvers

The following lessons take you through the basic techniques of flying an aircraft.

Lesson 2. Attitude Flying

For an explanation of the concept of attitude flying (using visual and instrument references to orient yourself), see "Attitude Flying" on page 97. This lesson takes you through a short flight as you look out the windows and watch the instrument panel to perform your information scan.

Lesson 3. Straight and Level Flight

This lesson teaches you to achieve and maintain straight and level flight. In straight and level flight, you maintain a constant heading and altitude.

You can achieve straight flight by holding a constant heading. Select two or more outside visual references (a town and a road, for example) to form an imaginary line, and keep the aircraft pointed along the line. While flying the line, check the heading indicator to confirm that you are flying a straight course. Compensate for slight deviations from the straight course by making very shallow turns, using the ailerons and rudder.

You can maintain level flight by holding a steady altitude, using pitch to compensate for altitude deviations and power to control airspeed.

For more information on the axis indicator, see "Looking Out the Window" on page 65.

You can maintain the pitch attitude for level flight by picking a point on the aircraft's nose (or using the axis indicator in Flight Simulator) and keeping it fixed relative to the horizon. Look at the altimeter occasionally to confirm that you're holding constant altitude. If you are deviating, change pitch (move the yoke forward or back) to return to the altitude you want.

There are two points to remember about level flight:

- The pitch required to maintain a steady altitude varies with power setting, aircraft loading, and airspeed.
- Although the vertical speed indicator shows how fast you are climbing or descending, don't try to maintain level flight by keeping this instrument set on zero. If you chase the gauge, the gauge's lag and the aircraft's momentum lag can cause the altitude to oscillate, turning straight and level flight into a roller-coaster ride. Instead, use the altimeter to make slight corrections and establish a constant altitude trend. You will notice, when glancing at the vertical speed indicator, that it hovers around zero.

Lesson 4. Turns

This lesson teaches you to enter, maintain, and roll out of a bank turn. A turn is a basic flight maneuver used to change or return to the heading you want. It involves close coordination of all three flight controls—ailerons, rudder, and elevator.

The Auto Coordination command is checked when you start Flight Simulator. This means the ailerons and rudder move together and you are automatically flying in coordinated flight. For more information on using the ailerons and rudder in coordinated and uncoordinated flight, see "Auto Coordination" on page 52.

You can turn your aircraft by banking the wings. When you change the direction of the wings' lift toward one side or the other, the aircraft is pulled in that direction. Apply coordinated aileron and rudder pressure to bank in the direction of the turn.

Turns are divided into three classes:

Shallow Bank angle less than 20 degrees, with the inherent stability of the aircraft acting to level the wings, unless you use some control force to maintain the bank.

Medium Bank angle between 20 and 45 degrees, at which the aircraft tends to hold constant without control force on the ailerons.

Steep Bank angle greater than 45 degrees, at which the overbanking tendency of the aircraft overcomes stability, and the bank tends to increase unless you apply pressure to the aileron controls to prevent it.

When making a turn, the aircraft tends to lose altitude. Because some of the lift is being used to turn the aircraft, this reduces the lift available to hold it up. Compensate by pulling back on the yoke to create more lift.

This lesson takes you through a 30-degree bank turn. Notice that you must add a bit of up elevator to maintain steady altitude and keep the aircraft stable in the bank. Once in the bank, the aircraft stays there until you apply aileron in the opposite direction to return to straight and level flight.

When coming out of a turn, remember to plan early. The aircraft is still turning when you make the transition from a turn to straight flight, so start straightening out 15 degrees early. Also remember that your lift increases as you come out of a turn. To keep from ballooning into the air as you straighten out, release the extra elevator that you used in the turn.

Lesson 5. Climbs

As with other maneuvers, you should perform climbs using both flight instruments and outside visual references.

This lesson teaches you to execute a simple climb. Climbs and climbing turns are basic flight maneuvers in which pitch attitude and power result in a gain in altitude.

The climb is broken into three phases: entry, constant climb, and level off.

On entry, pitch the aircraft nose up, and then add full power. Generally, add pitch before power. If you do not, the lack of resistance in level flight may cause your engine's revolutions per minute (rpm) to increase to a dangerously high level.

After entry, you are in a constant climb at full power. You must use pitch to control your climb speed. Hold pitch constant, and wait for airspeed to stabilize. Make slight changes in pitch until you reach the climb airspeed you want.

When climbing, you usually have some goal in mind: clearing obstacles as quickly as you can (greatest angle of climb), getting to a higher altitude as fast as possible (greatest rate of climb), or efficiency and taking it easy on the engine (cruise climb). The pilot's operating handbook (POH) for an aircraft lists airspeed for each case.

When nearing the target altitude, pitch downward to reduce your climb. As a general rule, start leveling off at 10 percent of your vertical velocity from your target altitude, in feet. For example, if you are climbing at 700 feet per minute, start leveling off at 10 percent of 700, or 70 feet, below your target altitude. Keep full power on until you reach cruise speed, and then adjust power to control airspeed in level flight.

Lesson 6. Cruise Descents

This lesson teaches you to control descents using power and pitch. Descents, like climbs, have three phases: entry, steady descent, and level off.

On entry, reduce power, and then use pitch to control vertical descent speed. Initially, reduce power by about 500 rpm. After you have established a descent, adjust power to maintain the cruise speed you want.

Once you are in a steady descent at the airspeed and sink rate you want, keep descending until you near your target altitude. When you are within 10 percent of your vertical speed from the goal altitude, start to level off. For example, at 500 feet per minute sink rate, start to level off 50 feet above your target altitude.

Level off by increasing throttle to cruise power. Use pitch to hold constant altitude in level flight.

Lesson 7. Slow Descents

This lesson teaches you to use slow descents during landing approaches, and to practice them before trying to land the aircraft. The descent in this lesson occurs at about 70 knots.

During a slow descent, reduce power greatly. With a low power setting, your airspeed drops dramatically. When it gets near the 70-knot goal, use pitch to control airspeed. Keep it at 70 knots by adjusting the elevator. If you slow down too much,

push your nose down to increase speed. If you want to maintain a certain sink rate (1000 feet per minute, for example), use power to make adjustments. The FAA and flight instructors vary in their thinking on the pitch/power rule, but most instructors advise using pitch to control airspeed and power to control vertical speed.

Takeoffs and Departure Climbs

The following two lessons on takeoffs teach you the basic takeoff method and the crosswind takeoff.

Lesson 8. Takeoff Roll

Taking off is relatively easy. You simply apply full power and accelerate until the aircraft reaches rotation speed (the takeoff roll) and leaves the ground (the liftoff). You then climb away from the runway (the initial climb).

Here are a few important points to note on takeoffs:

- Steer down the runway using the rudder.
- Strive for smooth throttle operation when applying power.
- When you reach rotation speed (about 70 knots), rotate the aircraft smoothly by pulling back on the yoke (using up elevator). Do not jerk the aircraft off the ground.
- Avoid too high a pitch and too low an airspeed, or you may stall.

After the takeoff, you will establish a standard climb configuration.

Lesson 9. Crosswind Takeoff

For more information on using the ailerons and rudder in coordinated and uncoordinated flight, see "Auto Coordination" on page 52.

Although wind compensation is a more advanced topic, we cover it in this basic lesson because of its importance in air traffic control. When you take off, you must stay in line with the runway to avoid drifting in the traffic pattern. In a real aircraft, this requires independent use of the ailerons and rudder, so when you start this lesson, the ailerons and rudder are not linked (uncoordinated flight).

To perform a crosswind takeoff, move down the runway applying right aileron into the right crosswind, which blows across the runway from right to left. Steer the aircraft down the runway using the rudder controls.

Once you lift off, apply the ailerons and rudder into the wind until you have turned enough so that your correction angle (crab angle) keeps you lined up with the runway. Look behind you to check for any drifting. Then level your wings and keep on a straight course, aligned with the runway.

Approach and Landing

To land your Cessna quickly and easily using the Land Me option, see "Flying Start" on page 14. You can also practice landings by choosing Quick Practice from the Options menu.

If you need a definition or explanation of a term, check the Glossary on page 251.

Landing is one of the most difficult skills for a beginner to learn. There are many landing techniques (short field, power approach, crosswind, and others), but the lesson in this section uses a simple, straight-in, normal landing under no-wind (or head-wind) conditions.

Lesson 10. Final Approach, Flare, and Touchdown

The way to assure a safe, easy landing is to set up a very good approach. You must approach the runway at the proper airspeed. If your approach is too fast, you will overshoot or hover above the runway for a long distance before touching down; if your approach is too slow, you may touch down before you reach the runway.

Approach the runway with the proper descent angle. Long, shallow approaches with power on can be dangerous, especially if there are many ground obstacles or you have an engine failure. Too steep an approach can make flaring difficult.

This lesson sets up a good approach that takes you toward the runway at 70 knots, with power almost cut and flaps down. This is a full-stall landing. During the approach, you control airspeed with pitch, just as you do in slow flight.

It takes practice to judge whether you are headed toward the runway. Landing on the first third of the runway is the goal. If you think you're going to overshoot, cut power. If you think you're coming in too short, add a bit of power. Never try to stretch the glide by only pulling back on the elevator to reach the desired landing spot. This will actually shorten the gliding distance if you don't add power simultaneously. You must maintain proper angle of descent and airspeed by coordinating pitch attitude and power changes.

Finally, when you're 10 to 20 feet above the ground, you start the roundout or flare. Pull back on the stick (apply up elevator) and try to hold the wheels about one foot above the runway as the aircraft bleeds off speed. Since your aircraft is designed to stall onto the runway at 50 knots, this requires more and more up elevator as the aircraft slows, until it finally loses all lift; the elevator is so far back that the angle of attack becomes great enough to make the aircraft settle onto the runway. Once on the ground, use the brakes to come to a stop.

Chapter 13 Advanced Flight Training

To choose a lesson, see "Using Flight Instruction" on page 100. Choose from the lessons in the Advanced Lesson Category.

Now it's time to go beyond the basics and learn some advanced flight techniques. These maneuvers teach you how the aircraft responds in marginal conditions and prepare you for emergencies.

Read each lesson first to familiarize yourself with the techniques involved, and then check your progress while you fly.

Stalls

When you fly an aircraft too slowly and its angle of attack to the relative wind is too high, the aircraft stalls and loses all lift. One wing usually stalls slightly before the other because conditions are never totally symmetrical for both wings. Losing all the lift on one wing causes the aircraft to bank quickly in the direction of the stalled-out wing. This can create a roll. Modern aircraft are designed with some twist in their wing, which gives the portion of the wing closest to the aircraft a higher angle of attack, making the wing surface near the aircraft's center stall first. This greatly reduces the rolling tendency.

Lesson 1. Full Stall—Power Off (Approach)

If you need a definition or explanation of a term, check the Glossary on page 251.

You usually perform a power-off stall with normal landing approach conditions to simulate accidental stalls during landing. Before executing a power-off stall, it's important to practice in an area that is clear of traffic and to be high enough above ground level to assure recovery after the stall, with lots of altitude to spare.

You must recognize instantly when a stall has occurred and take prompt action to prevent a prolonged stall condition or a secondary stall. When recovering from a stall, it is important to avoid excessive airspeed, excessive loss of altitude, or a spin.

To perform a power-off stall

1. Put the aircraft into landing configuration, and cut the power (lower the landing gear and flaps when airspeed is below 85 knots—within the white arc on the airspeed indicator).
2. Turn on the carburetor heat indicator to prevent icing.
3. As the aircraft slows, use the elevator to hold constant altitude flight.
4. When you reach approach speed, put the aircraft into an approach attitude, as if coming in for a landing. Adjust pitch to maintain airspeed.

5. When the approach attitude and airspeed have stabilized, raise the nose (up elevator) to an attitude that will induce a stall.
6. Maintain directional control with the rudder, and hold the wings level with the ailerons until the stall occurs.

   You can tell when you are in a full stall by the full-up elevator, high sink rate, uncontrollable nose-down pitching, and by the buffeting or shaking aircraft.

Note the altitude loss. You don't want a stall like this to happen near the ground.

To recover from a power-off stall

1. Reduce the angle of attack by releasing back elevator pressure to lower the nose of the aircraft.
2. Apply full throttle smoothly.
3. Lower the nose as necessary to regain flying speed, and then return to straight and level flight.
4. When in level flight, throttle down to cruise power and retract the flaps and landing gear.

Lesson 2. Full Stall—Power On (Departure)

You practice a power-on stall recovery from a straight climb, and a climbing turn with a 15- to 20-degree bank, to simulate an accidental stall occurring during takeoff. Although power-on stalls actually occur most frequently near the ground, you must practice them at an altitude of at least 3000 feet for safety.

You must recognize instantly when a stall has occurred and take prompt action to prevent a prolonged stall condition or a secondary stall. When recovering from a stall, it is important to avoid excessive airspeed, excessive loss of altitude, or a spin.

To perform a power-on stall

1. Attain climb attitude and climb power.
2. Raise the nose to an attitude that is obviously impossible to maintain.
3. Hold that attitude until a stall occurs.

   You can tell when you are in a stall by the full-up elevator, high sink rate, uncontrollable nose-down pitching, and by the buffeting or shaking aircraft.

To recover from a power-on stall

1. Reduce the angle of attack by releasing back elevator pressure.
2. Apply full throttle smoothly.
3. Lower the nose to regain flying speed, and return to straight and level flight.
4. When in level flight, throttle down to cruise power.

Lesson 3. Accelerated Maneuver Stall

For more information about aircraft loading, design maneuvering speed, and weight and balance limitations, see the pilot's operating handbook (POH) for your aircraft or consult "Flight Training Books" on page 188.

This is the final stall lesson. Gross weight and load factors influence the airspeed at which an aircraft stalls. At the same gross weight, configuration, and power setting, an aircraft always stalls at the same indicated airspeed if no acceleration is involved.

Excessive maneuvering loads imposed by turns, pull-ups, or other abrupt flight-path changes can cause a stall. Stalls from such flight situations are called accelerated maneuver stalls, a term that has no reference to the airspeeds involved.

In this lesson, it is assumed that your aircraft has a type certification of the Utility or Aerobatic category and is approved for accelerated maneuvers. The object of demonstrating this stall is to show how it can occur and how to recover from it quickly. You should never allow a prolonged stall condition.

To perform an accelerated maneuver stall

1. Begin a 45-degree banked turn.

   Make sure your flaps are not extended.
2. Apply increasing back pressure on the elevator, which increases the centrifugal force and the wing loading.
3. After airspeed reaches the design maneuvering speed (the maximum speed at which application of full available aerodynamic control will not overstress the aircraft), increase back pressure until a stall occurs.

You can find the design maneuvering speed in the POH for your aircraft.

To recover from an accelerated maneuver stall

▶ Release back elevator pressure and increase power.

Other Advanced Instruction

The following lessons are not as dramatic as stalls, but demonstrate more advanced flight techniques.

Lesson 4. Uncoordinated Flight

To choose a lesson, see "Using Flight Instruction" on page 100. Choose from the lessons in the Advanced Lesson Category.

An aircraft is in coordinated flight when it's flying straight through the relative wind rather than slightly sideways through it. This is the most efficient and safe attitude. The ball in the inclinometer at the bottom of the turn coordinator shows aircraft coordination. If it is centered, the aircraft is coordinated.

The Auto Coordination command on the Sim menu links rudder and ailerons together. When this command is turned on, the appropriate amounts of rudder for yaw and ailerons for bank are applied in turns to keep the aircraft coordinated. In this lesson, the Auto Coordination command is turned off, so you can examine the individual effects of the ailerons and rudder. If you bank the aircraft with the ailerons and a straight rudder, the result is a slow, sloppy, uncoordinated turn. If you use the rudder alone, the aircraft yaws as it drags itself around a turn with the coordination ball pushed to one side. This is known as a slip or skid, depending on the rate of turn, and should be avoided during normal flight, because it can cause an accidental spin.

To use Auto Coordination

- From the Sim menu, choose Auto Coordination.

  A check mark beside the command indicates that the command is turned on. If you choose Auto Coordination again, the check mark is no longer displayed and the command is turned off.

Lesson 5. Slips

This lesson gives you practice flying in an uncoordinated attitude—the slip. You perform a slip by banking an aircraft using the ailerons while applying opposite rudder. Banking tends to make the aircraft turn, but applying opposite rudder stops this tendency. In a slip, the rate of turn is too slow for the angle of bank, and the ball in the inclinometer moves to the inside of the turn. The aircraft ends up flying at a constant heading but in a bank. Since the aircraft is banked, side forces are produced, and the aircraft moves to the right or left, depending on the direction of bank.

This effect is useful when landing in a crosswind, where you must keep the aircraft lined up with the runway, but the wind makes it necessary to add a left or right component to your speed.

When in a slip, drag is increased and speed is decreased, because the aircraft is uncoordinated.

Lesson 6. Steep Turns

If you need a definition or explanation of a term, check the Glossary on page 251.

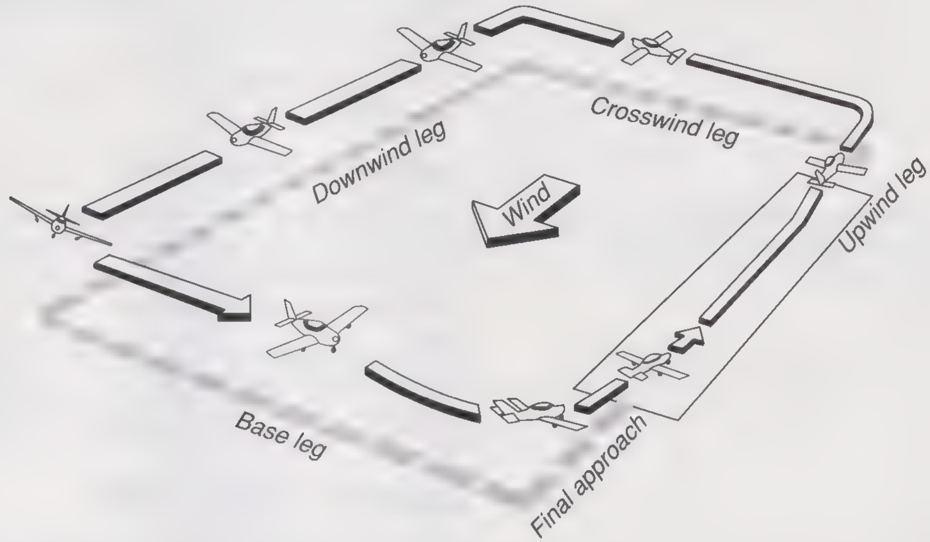
Steep turns of 50 to 60 degrees border on the aerobatic. In this lesson, you apply full power and you roll into a turn. Then you increase up elevator to maintain altitude, but when you roll out of the turn, it's important to release up elevator. Ballooning out of a steep turn is a common mistake.

Before starting a steep turn, make sure that the area is clear of other air traffic. During a steep turn, do not fixate on the nose of the aircraft. In order to maintain altitude, as well as orientation, you'll need to divide your attention and stay aware of the relative position of the nose, the horizon, the wings, and the amount of turn.

Lesson 7. Traffic Pattern

A standard traffic pattern (counterclockwise) assures that air traffic flows into and out of airports in an orderly manner. The standard traffic pattern is rectangular and consists of four "legs" positioned in relation to the runway in use: upwind, crosswind, downwind, and base. From base leg, you turn onto final approach. Flying a correct traffic pattern is essential to setting up a good landing approach. Traffic patterns, and their direction and altitude, are established based on local conditions. Use the standard left-hand pattern unless an airport displays approved visual markings indicating that you should make turns to the right.

Standard Left-Hand Traffic Pattern



Lesson 8. VOR Tracking with Wind

For more information on navigation instruments and how to use them, see "Navigation Course" on page 127.

In this lesson, the directional gyro is covered so that you can't use it to find your way. Instead, you tune in the VOR station at the Champaign-Urbana airport (CMI) on the NAV 1 radio and center the omni-bearing indicator (OBI) needle. You fly a course to the VOR and notice the change in the distance measuring equipment (DME) distance to station. The needle starts to drift due to the wind. Center the needle, but this time compensate for the wind by heading into it slightly. The needle stays centered as you fly directly toward the station with the corrected heading.

Chapter 14 Aerobatics Course

In this chapter you learn to fly seven aerobatic maneuvers. Included are simple aerobatics (spin, loop, and aileron roll) and more complex aerobatics (inverted flight, Split "S," Immelmann, and Hammerhead Turn). In these lessons, it is assumed that your aircraft has a type certification of the Utility or Aerobatic category and is approved for accelerated maneuvers. For those maneuvers that are rated in the Aerobatic category because the bank is more than 60 degrees or the pitch is more than 20 degrees (all but the spin), you must wear a parachute.

Simple Aerobatics

To choose a lesson, see "Using Flight Instruction" on page 100. Choose from the lessons in the Aerobatic Lesson Category.

Start with the spin, loop, and aileron roll. Then you can move on to more complex maneuvers.

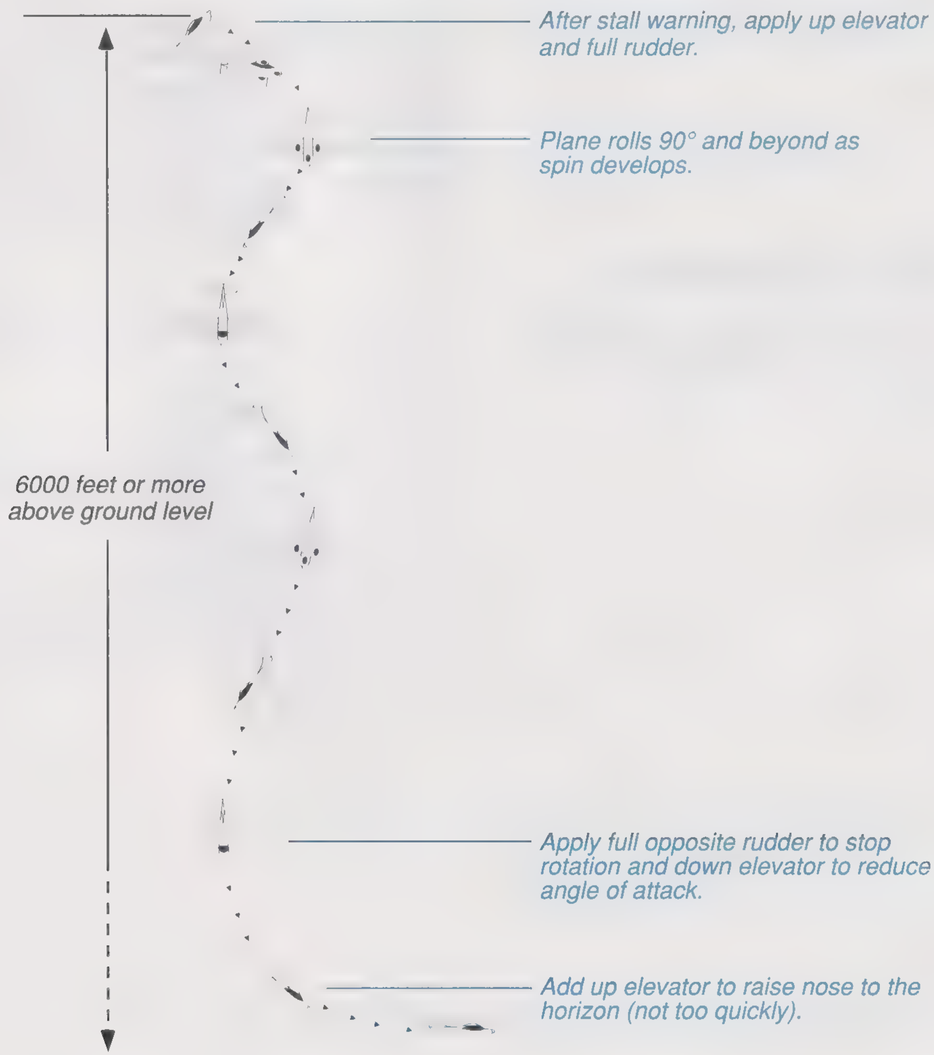
Lesson 1. The Spin

A spin is a stall where one wing drops and puts the aircraft into a corkscrew descent. The aircraft remains in the spin until you use the controls to stop it.

Although the spin is the simplest aerobatic maneuver, it can be very dangerous. To fly a spin, your aircraft must have a type certification of the Utility category and must have specific approval for spin maneuvers; otherwise, intentional spins are restricted. Five to 10 percent of all small aircraft accidents are caused by accidental spins, so it's a good idea to become proficient in this aerobatic maneuver, especially the recovery phase.

The Spin

Before beginning the spin, turn off Auto Coordination on the Sim menu.



To fly a spin

1 From the Sim menu, choose Auto Coordination so that the command is turned off (not checked), and your aircraft is in uncoordinated flight.

2 Climb to 6000 feet above ground level (AGL).

3 In cruising flight (no flaps), bring the throttle back to idle power.

4 Use up elevator to raise the nose slowly to a point slightly above the horizon.

5 Hold this attitude until the stall warning sounds.

6 To spin left or right, apply additional up elevator and full rudder left or right, respectively.

The aircraft rolls to a 90-degree bank and beyond as the spin develops.

To recover from a spin

1 Recover from the stall by using full opposite rudder to stop rotation.

2 Forcefully and firmly apply down elevator to reduce your angle of attack.

Be careful not to apply elevator too quickly, or you'll risk another stall.

3 As the spin rotation stops, neutralize the rudder.

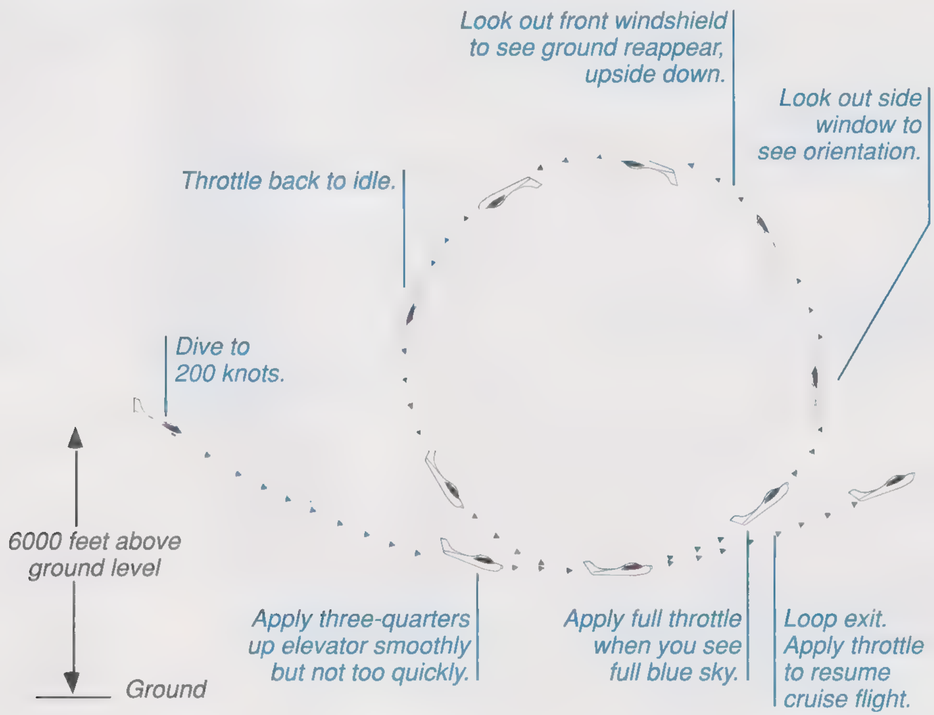
4 Complete your recovery by slowly applying up elevator to raise the nose to level flight.

Lesson 2. The Loop

This is the second-easiest aerobatic maneuver. You use elevator and throttle to pitch the aircraft through 360 degrees, flying a vertical circle in the sky. The key to a successful loop is to obtain enough airspeed to allow the aircraft to fly through the complete circle without stalling.

The Loop

Before beginning the loop, turn on Auto Coordination on the Sim menu.



To fly a loop

1. From the Sim menu, choose Auto Coordination so that the command is turned on (checked), and your aircraft is in coordinated flight.
2. Get into normal cruise flight, with flaps up, and normal cruise throttle.
3. Use down elevator to dive rapidly until airspeed reaches about 200 knots.
4. Apply up elevator smoothly but not too rapidly, until the elevator is about three-quarters up.
5. After the nose rises and you see sky through your windshield, apply full throttle.

   Look out a side window to see your pitch orientation.

For more information on view direction, see "View Controls" on page 66.

6. When the loop is almost half complete, switch to forward view and watch the earth reappear upside down.
7. When the loop is three-quarters complete, bring the throttle back to near idle to avoid over-revving your engine as you dive.

To recover from a loop

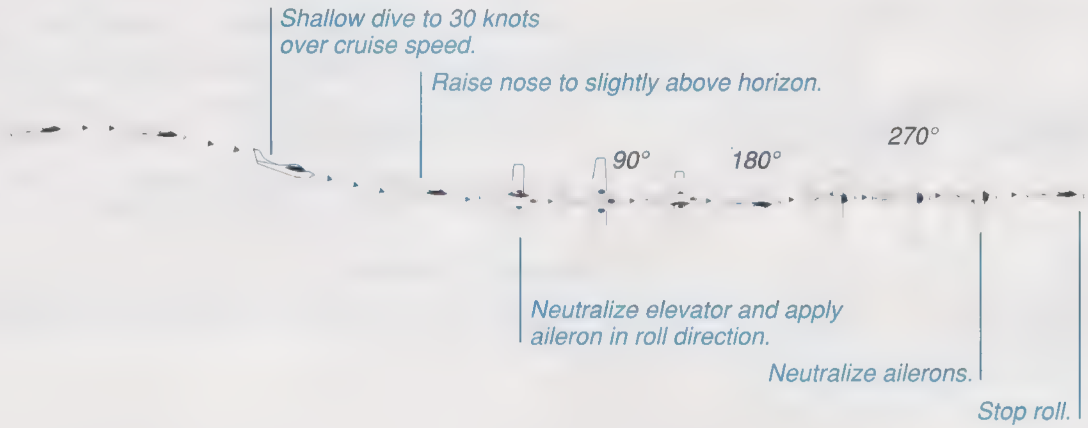
- As you come out of the loop, level off, apply throttle, and resume normal cruise flight.

Lesson 3. The Aileron Roll

In this maneuver, the ailerons are used to roll the aircraft through 360 degrees of bank. This maneuver is fairly simple because your aircraft is capable of very rapid roll rates. One of the most difficult aspects of the aileron roll is to stop rolling at the proper time.

The Aileron Roll

Before beginning the aileron roll, turn off Auto Coordination on the Sim menu.



To fly an aileron roll

1. From the Sim menu, choose Auto Coordination so that the command is turned off (not checked), and your aircraft is in uncoordinated flight.
2. Get into cruise configuration, and begin a shallow dive to increase your airspeed to 30 knots above cruise speed.
3. Use up elevator to raise the nose slightly above the horizon.
4. Neutralize the elevator, and apply left or right aileron, depending on which direction you want to roll.

   The aircraft will roll past vertical (90-degree bank), upside down (180 degrees), vertical again (270 degrees), and then roll toward level.

To recover from an aileron roll

1. Begin to neutralize ailerons shortly before you are level again.

   If properly timed, you will be near level attitude when the roll stops.
2. Resume cruise flight.

Complex Aerobatics

The following aerobatic maneuvers are more complex than the spin, loop, and aileron roll and require more concentration and control.

Lesson 4. Inverted Flight

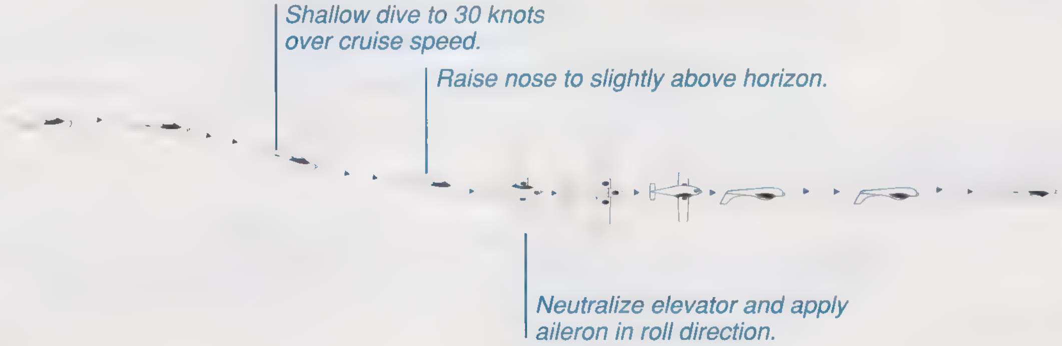
Inverted flight can be disorienting. This maneuver is an extension of the aileron roll, but you must begin neutralizing your ailerons when the aircraft rolls past vertical so that you stop the roll as the aircraft turns upside down.

At this point, the horizon and artificial horizon (on your control panel) are upside down. The elevator works backward. Pushing forward "drops" the nose toward the sky, but the ailerons work as usual. If you start losing altitude while upside down, remember to push the nose down (down elevator).

Come out of inverted flight by completing the last half of your aileron roll.

Inverted Flight

Before beginning the inverted flight maneuver, turn off Auto Coordination on the Sim menu.



To fly in inverted flight

1. Begin an aileron roll.
2. Start neutralizing your ailerons shortly after rolling past 90 degrees to stop the roll when the aircraft is upside down.
3. Use reverse elevator to control pitch and establish level, inverted flight.

To recover from inverted flight

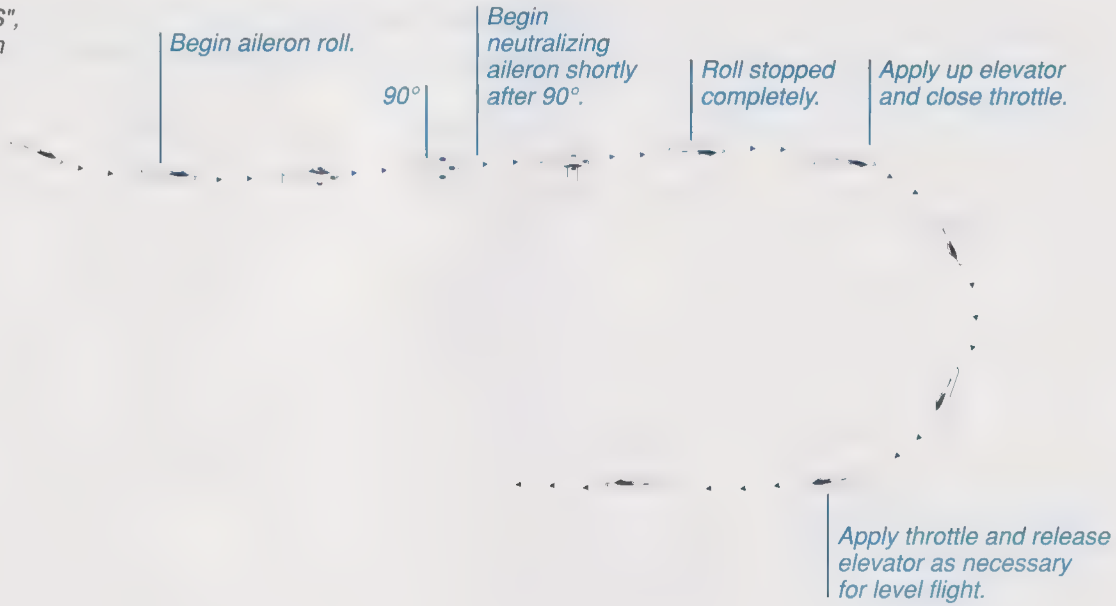
- Apply aileron to complete the last half of the aileron roll.

Lesson 5. The Split "S"

This maneuver is actually an alternate way of recovering from inverted flight. Instead of completing the aileron roll, you pull back on the control yoke, close the throttle, and fly the last half of a loop.

The Split "S"

Before beginning the Split "S", turn off Auto Coordination on the Sim menu.



To fly a Split "S"

1. Begin an aileron roll.
2. Start neutralizing your ailerons shortly after rolling past 90 degrees to stop the roll when the aircraft is upside down.
3. Once in inverted flight, apply up elevator and close the throttle to complete the last half of a loop.

To recover from a Split "S"

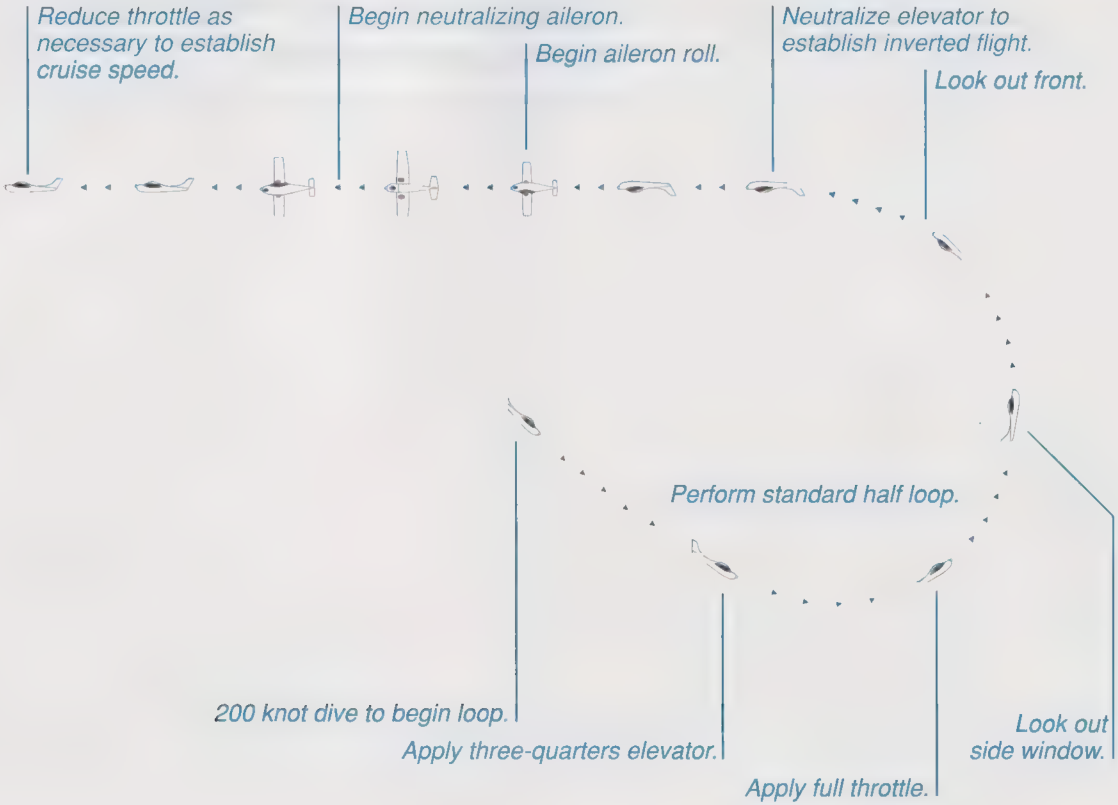
- As you come out of the loop, level off, apply throttle, and resume normal cruise flight.

Lesson 6. The Immelmann

This maneuver was invented by a German ace, Max Immelmann, who used it as a tactical maneuver to evade other aircraft in a dogfight. The Immelmann is a half loop followed by a half roll (as opposed to the Split "S," which is a half roll followed by a half loop).

The Immelmann

Before beginning the Immelmann, turn off Auto Coordination on the Sim menu.



To fly an Immelmann

1. Dive as though starting a loop.
2. Note your heading, and begin the loop.
3. Neutralize the elevator the moment the aircraft becomes exactly inverted at the top of the loop.

   This stops the aircraft in inverted flight at a relatively slow airspeed.
4. Follow through with a half roll to level off on top.

To recover from an Immelmann

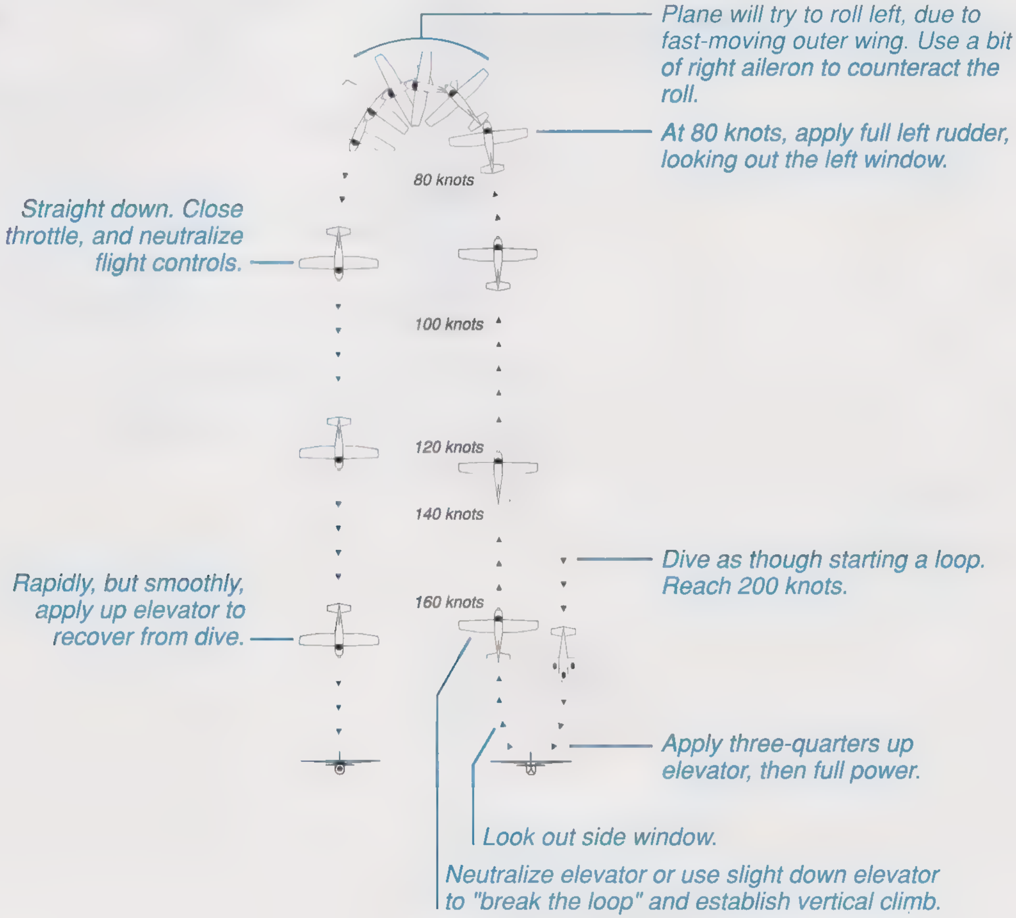
- Fly straight and level until you reach cruise speed.

Lesson 7. The Hammerhead Turn

The final aerobatic maneuver is the Hammerhead Turn or Hammerhead Stall. It is often referred to as a wingover, since the term describes what the aircraft does, but wingover also describes other less difficult maneuvers.

The Hammerhead Turn

Before beginning the Hammerhead Turn, turn off Auto Coordination on the Sim menu.



To fly a Hammerhead Turn

1. From the Sim menu, choose Auto Coordination so that the command is turned off (not checked), and your aircraft is in uncoordinated flight.
2. Dive as though starting a loop.
3. Apply three-quarters up elevator and full throttle for a vertical climb.
4. Look out the side window. Just as the bottom of the wing comes up perpendicular to the horizon, neutralize the elevator or apply slight down elevator.

   You are now in a vertical climb.
5. When airspeed drops to about 80 knots, leave the elevator unchanged and apply full left or right rudder, looking out the left or right window respectively.
6. As the aircraft yaws at the top of the Hammerhead, the fast-moving outer wing develops more lift and tends to make you roll. Carefully use a bit of opposite aileron to counteract this roll.
7. Once the nose has yawed 180 degrees to straight down, close the throttle, neutralize all flight controls, and then rapidly but smoothly apply up elevator to return from the vertical dive back to level flight.

To recover from a Hammerhead Turn

1. Turn to the proper heading (this maneuver changes your heading by 180 degrees).
2. Resume cruise flight.

Chapter 15 Navigation Course

For information about the location of the navigation instruments, see "Instrument Panel and Radio Stack" on page 43.

This chapter teaches you how to use flight instruments and visual cues to navigate your aircraft. You'll learn to implement different navigation methods depending upon visibility conditions and the duration of your flight. You'll also learn about the Command Flight Path Display (CFPD), an important Electronic Flight Instrument System (EFIS).

Pilotage

Flying cross-country from one visible landmark (such as a river or a railroad) to another, using only a flight chart, is called pilotage. This is a simple but sometimes impractical navigation method because you often fly a zigzag course, which lengthens your flight time.

You do not need any special equipment, but you must fly at fairly low altitudes so that you can identify landmarks. You cannot use pilotage in areas that lack adequate landmarks or when visibility is poor.

Dead Reckoning

Dead reckoning is the navigation of an aircraft based on airspeed, course, heading, wind direction and velocity, ground speed, and elapsed time. You use a mechanical or electronic flight computer to calculate these factors. In addition, you use a navigation plotter to measure the direction and distance of your flight. You then point the aircraft in the direction of your destination, add a correction factor for wind, and fly at a set speed for the amount of time it takes to cover the distance.

You seldom use dead reckoning by itself because even the slightest deviation in course could place you miles from your target destination.

The most common form of visual flight rule (VFR) navigation is a combination of dead reckoning and pilotage—you fly in a computed direction and correct for errors using landmarks that come into view along the way. There may be stretches where you don't see any landmarks for miles, but using dead reckoning over these miles keeps your aircraft on course and avoids the zigzagging of pure pilotage.

Navigation Systems

Flight Simulator has several types of radios and communication equipment, including a communication radio (COM 1), two navigation radios (NAV 1 and NAV 2) and two omni-bearing indicators (OBIs), distance-measuring equipment (DME), a transponder, and an automatic direction finder (ADF). This section teaches you how to set and use these navigation instruments.

Using the Communication Radio

For more information on the phonetic alphabet, see page 257 in the Glossary.

You use the communication radio (COM 1) to tune in to the automatic terminal information service (ATIS) for current information on weather, ceiling, visibility, temperature, dew point, magnetic wind direction and velocity, altimeter setting, runway use, and airport cautionary notices. ATIS broadcasts are labeled with successive letters from the phonetic alphabet, such as "information alpha" or "information bravo." The ATIS message is displayed in a small window at the bottom of your view window. The sectionals in Appendix B, "Sectionals, Directories, and Runway Maps" on page 211 note the ATIS frequency for each airport at which ATIS service is available.

You can set COM radio frequencies with the mouse, keyboard, or Nav/Com menu.

To set the COM radio with the mouse

- On the instrument panel, click the digits you want to change.

  The full megahertz (MHz) frequency and fractional frequency adjust separately. To decrease the setting, click the left side of the digits; to increase the setting, click the right side of the digits.

To set the COM radio with the keyboard

1. Press C to select the full MHz frequency, or press C twice to select the fractional frequency.
2. Press PLUS SIGN or MINUS SIGN on the main keyboard (not the numeric keypad) to change the selected digit.

To set the COM radio with the Nav/Com menu

1. From the Nav/Com menu, choose Communication Radio.

   Flight Simulator displays the Communication Radio dialog box.

For more information on sectional aeronautical charts, see "Reference Books for Pilots of All Levels," on page 189.

2 In the COM 1 Frequency box, type the COM Radio frequency you want.

Check your sectional aeronautical chart for airport ATIS frequencies.

In many of the situations provided with Flight Simulator, the COM radio is set to a frequency that is one digit less than the frequency of the nearest airport. When you open these situations, all you have to do is increase the frequency one digit to see the ATIS broadcast for the nearest airport. For example, when you open the Chicago Meigs Field Runway 36 situation, the COM radio frequency is set to 120.30. If you increase the frequency one digit to 121.30, Flight Simulator displays the ATIS broadcast for Meigs Field.

3 Drag the Communication Rate slider to set a slower or faster rate of communication.

If you have trouble keeping up with radio messages on screen, choose a slower rate.

4 Choose the Listen To Latest Message button if you miss a message and want to listen to it.

5 Choose the Send Message button to start up communications with Air Traffic Control.
–or–
In dual-player flight, choose the Send Message button to contact your flying companion.

You can receive 720 radio channels with 25 kHz separation if you choose Preferences from the Options menu, choose the Instrument button, and then choose the 25 kHz COM Frequency Adjustability check box.

6 Choose the OK button.

If you want to cancel changes and reset to the original COM frequency, choose the Cancel button.

Using the Navigation Radios

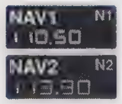
The navigation radios are important navigational aids. You use them to tune in very high-frequency omnidirectional range (VOR) radio beacons so that you can fly toward or away from them. VORs are radio stations that transmit an omnidirectional synchronization signal followed by a circular sweeping directional signal. The NAV receivers in the aircraft decode these signals to determine what angle or radial you are on. Think of radials as directional beams radiating outward like the spokes of a wheel from the VOR station.

You can also use the NAV 1 radio to tune in an Instrument Landing System (ILS). For detailed information about instrument flying, see "Reference Books for Pilots of All Levels" on page 189.

The Flight Simulator instrument panel has two navigation radios—NAV 1 and NAV 2—so that you can tune in two VOR beacons at once. This is useful for cross-checking your position.

You must set the navigation radios to a VOR frequency to receive the appropriate signal. On a real aircraft, there are two knobs that set the frequency. One sets the full megahertz (MHz) frequencies (121, 122, 123, and so on), and the other sets the fractional frequencies in 50 kilohertz (kHz) increments (.00, .05, .10, and so on).

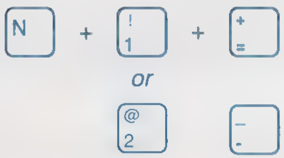
To set the NAV radios with the mouse



- On the instrument panel, click the digits you want to change.

  The full megahertz frequency and fractional frequency adjust separately. To decrease the setting, click the left side of the digits; to increase the setting, click the right side of the digits.

To set the NAV radios with the keyboard



1. Press N, the NAV key.
2. If you want to adjust a NAV radio other than the one you most recently adjusted, press 1 for NAV 1 or 2 for NAV 2.
3. To change the full megahertz frequency, press PLUS SIGN or MINUS SIGN on the main keyboard (not the numeric keypad).
4. To change the fractional frequency (.00, .05, .10, and so on), press the N key twice in rapid succession, and then press either PLUS SIGN or MINUS SIGN until you reach the appropriate setting.

   For example, to advance from 111 to 113 MHz, press N, and then press PLUS SIGN twice. To go from .55 to .40, press N twice, and then press MINUS SIGN three times.

Besides the VORs listed in Appendix B, Flight Simulator includes VORs for the entire United States. Consult the FAA or Jeppesen Sanderson sectionals for VOR frequencies and tune them in. For more information on sectionals, see "Reference Books for Pilots of All Levels" on page 189.

To set the NAV radios with the Nav/Com menu

1. From the Nav/Com menu, choose Navigation Radios.

   Flight Simulator displays the Navigation Radios dialog box.

2. In the Frequency boxes, type the frequency you want for NAV 1 or NAV 2.

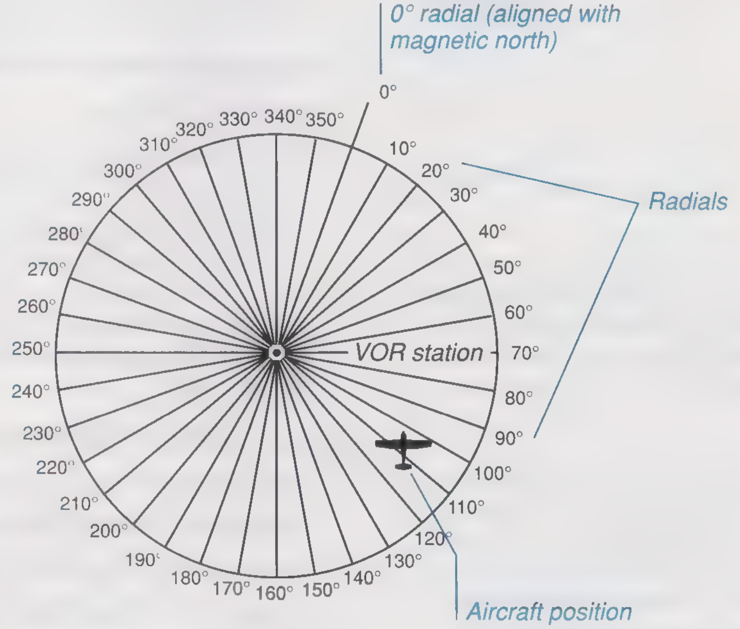
   Check Appendix B, "Sectionals, Directories, and Runway Maps" on page 211 for the VOR frequency for each airport.

3. Choose the OK button.

   If you want to cancel changes and reset to the original NAV frequencies, choose the Cancel button.

VOR Station and Radials

Very high-frequency omnidirectional range (VOR) stations are radio stations that transmit an omnidirectional identification signal followed by a circular sweeping directional signal. The NAV receiver in the aircraft decodes these signals to determine the angle or radial from the station you are on. You can think of radials as directional lines radiating outward from the VOR station like the spokes of a wheel.



Using the Omni-Bearing Indicators

Flight Simulator has two omni-bearing indicators (OBIs). The top OBI corresponds to the NAV 1 radio. The bottom OBI corresponds to the NAV 2 radio.

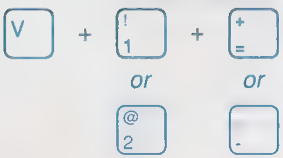
The OBIs are used with the NAV radios to tune in VOR radio stations. The OBI or VOR indicator is a panel-mounted instrument that lets you determine what VOR radial your aircraft is on. It also helps you fly along radials toward or away from the VOR station.

To set the OBIs with the mouse

- On the instrument panel, click the left or right side of the digits you want to change.

  To decrease the setting, click the left side of the digits; to increase the setting, click the right side of the digits. The three digits adjust together.

To set the OBIs with the keyboard



1. Press V, the VOR key.
2. If you want to adjust an OBI other than the one you most recently adjusted, press 1 for the top OBI or 2 for the bottom OBI.
3. Press PLUS SIGN or MINUS SIGN on the main keyboard (not the numeric keypad) to choose the correct course and reciprocal course readings.

   Each keystroke adjusts the course selector by 1 degree. Holding down the PLUS SIGN or the MINUS SIGN key cycles rapidly through the degree settings. Pressing SHIFT+PLUS SIGN or SHIFT+MINUS SIGN adjusts the course selector in 10-degree increments.

OBI 2 and the automatic direction finder (ADF) share instrument-panel space. Press SHIFT+TAB to switch between OBI 2 and the ADF.

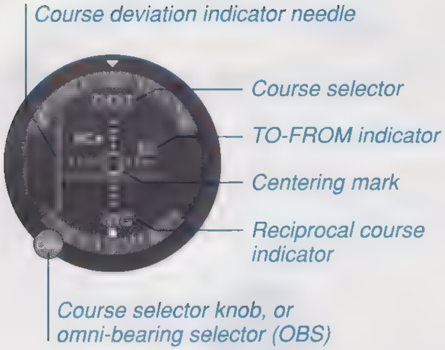
To set the OBIs with the Nav/Com menu

1. From the Nav/Com menu, choose Navigation Radios.

   Flight Simulator displays the Navigation Radios dialog box.
2. Choose the VOR 2 Gauge Active check box to use both VOR 1 and VOR 2.
3. In the OBS Heading boxes, type the OBS headings.
4. Choose the OK button.

   If you want to cancel changes and reset to the original OBS heading frequencies, choose the Cancel button.

You use the omni-bearing selector (OBS), also referred to as the course selector knob, to select the radial on which you want to fly or to find the radial you are currently intercepting. Its numeric value is displayed at the top of the OBI.



OBI readings indicate your aircraft's position relative to the VOR station radial. The aircraft's heading has no effect on the OBI reading. However, if you want to fly directly toward a VOR, you can use the course selector to estimate the heading you must fly to remain aligned with the radial.

Course Deviation Indicator (CDI) A vertical needle that shows your deviation from the VOR radial set by the course selector. If the needle is to the right of center, the radial lies to the right of your current position. On windy days, you have to compensate for any crosswinds that may blow you off your radial by adjusting your heading to the left or right.

Course Selector A numeric value that appears at the top of the OBI. This number indicates the radial to which your OBI receiver is set.

Course Selector Knob or Omni-Bearing Selector (OBS) A knob used to select the radial on which you want to fly or to find the radial you are currently intercepting. The course selector value appears at the top of the OBI. The NAV receiver interprets the radial on which the aircraft is currently located and displays the relationship between this and the selected course on the OBI. You can "read out" the current radial by turning the course selector knob until the CDI needle is centered and by observing the TO-FROM indicator to resolve any ambiguity.

On windy days, you have to compensate for crosswinds that may blow you off your radial by adjusting your heading to the left or right.

TO-FROM Indicator An indicator that shows whether you are in the TO or FROM hemicircle of radials. When the TO indicator is displayed, the CDI shows course deviation as described above if you are flying toward the VOR station. When the FROM indicator is displayed, the CDI works as outlined above if you are flying away from the VOR station.

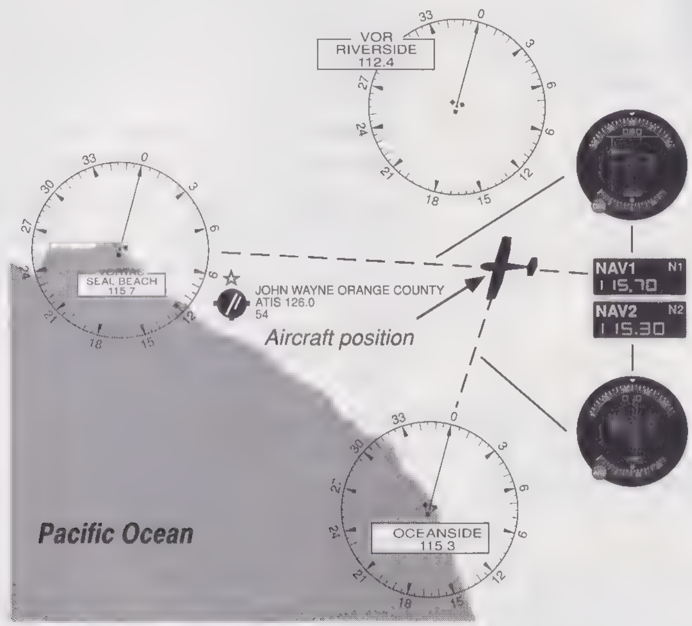
If you intercept a radial and decide to fly along it, only to find that the needle sense is backward, adjust the course selector to 180 degrees from its current position. This changes the FROM to TO, or vice versa, and reorients the needle.

The TO-FROM indicator prevents disorientation. If you want to, you can fly toward a VOR station on the FROM radial and, as long as the CDI needle is centered, you will stay on course. However, the course deviation noted on the indicator will be backward. If the needle is to the right of center, you will have to fly to the left to intercept the radial again. You can avoid this confusion by always flying on the FROM radial when headed away from the station and flying on the TO radial when headed toward the station.

Uses and Advantages of Two NAV Radios

Flight Simulator provides two NAV radios and corresponding OBIs so that you can tune in two VORs simultaneously.

Using Two VORs to Identify Position



There are several advantages to using two NAV radios:

- You can identify your exact position by tuning in two VORs and finding the radial you are currently intercepting for each VOR. The point at which the two radials intersect is your position. When determining your position using radial intercepts, you must be careful that you are on the radial shown by the course selector and not on the one 180 degrees away from it. It is possible to center the needle at two course selector settings: one on the radial you are really on, with FROM displayed on the TO-FROM indicator, and the other one on the radial 180 degrees away, with TO displayed. Make sure FROM is displayed, and then read the radial on the course selector. If TO is displayed, change the course selector so that FROM is displayed.

- You can use the two NAV radios to determine your flight progress while flying toward a VOR. If you are flying toward a VOR tuned in on NAV 1, set NAV 2 to another VOR and set its OBI to a radial you will be crossing on your flight path. When you cross this preselected checkpoint, the VOR needle for NAV 2 swings past center.
- With two NAV radios, you can rapidly switch from one radio to the other (on which you have your VOR frequency and heading already adjusted) when air traffic control tells you to immediately take up a course toward the VOR station.
- A second radio can serve as a backup if the other fails.

Using the Distance-Measuring Equipment

A VORTAC is a combination of two facilities: VOR, which picks up information on azimuth or magnetic bearing, and Tactical Air Navigation (TACAN), which picks up distance information.

Most VORs (VORTACs and VOR-DME facilities) have distance-measuring equipment (DME) capabilities. DME 1 and DME 2 tell you how many nautical miles you are from the station tuned on NAV 1 and NAV 2.

Occasionally, the DME is blank when you have a valid VOR tuned in and working. The DME system does not have the range that the VOR directional navigation signal has. The ground-speed reading is accurate only when you are traveling directly to or from the station. Flight in any other direction gives you an unreliable reading. If you are so far away from a VOR that its DME is no longer working, you are too far from the VOR to rely on its directional signal for navigation. In such a case, switch to a new VOR.

To choose either DME 1 or DME 2

F + ! 1

or

F + @ 2 *Alternate source NAV 1 or NAV 2.*

+ = *Toggle between distance from station and speed toward station.*

▶ Press the F key, and then press 1 or 2 to choose DME 1 or DME 2.

You can also read ground speed in knots to or from a station and receive the timed average of speeds over the last few minutes. This is the component of your speed toward the station and reflects ground speed only when you are flying directly to or from the station.

To see your ground speed

▶ Make sure you press F+1 or F+2 to choose DME 1 or DME 2, and then press the PLUS SIGN key to see your ground speed.

The DME on the instrument panel displays "KT" for speed in knots.

To see your distance from the VOR

▶ Make sure you press F+1 or F+2 to choose DME 1 or DME 2, and then press the PLUS SIGN key until you see your distance from the VOR to which you are tuned.

The DME on the instrument panel displays "NM" for distance in nautical miles.

Using the Transponder

The transponder is an electronic device aboard your aircraft that enhances your aircraft's identity on an air traffic control (ATC) radar screen. A coded signal transmitted by a ground-based radar beacon transmitter-receiver causes your aircraft's transponder to reply automatically with a specific coded signal, which produces a distinctive return on the air traffic controller's radar screen.

When you request takeoff clearance, ATC asks you to transmit a four-digit code, or "squawk code." The message from ATC (including the requested transponder code) scrolls across the top of your screen. ATC uses the number your transponder transmits to track you on its radar screen.

To set the transponder with the mouse

▶ On the instrument panel, click the digits you want to change.

The four digits adjust separately. Click each digit until the value you want is displayed.

To set the transponder with the keyboard

1 Press T once to select the left digit, twice to select the second digit, three times to select the third digit, or four times to select the fourth digit.

2 Press PLUS SIGN or MINUS SIGN on the main keyboard (not the numeric keypad) to change the selected digit.

To set the transponder with the Nav/Com menu

1 From the Nav/Com menu, choose Transponder.

Flight Simulator displays the Transponder dialog box.

2 In the Transponder Code box, type in the squawk code.

3 Choose the OK button.

If you want to cancel changes and reset to the original transponder code, choose the Cancel button.

Using the Automatic Direction Finder

The automatic direction finder (ADF) and the OBI 2 share instrument-panel space. Press SHIFT+TAB to switch between the OBI 2 and the ADF.

The automatic direction finder (ADF) is a system that lets you home in on non-directional radio beacons (NDBs) and commercial broadcast stations. Unlike the VOR, ADF does not rely on line-of-sight transmissions. This allows reliable navigation at lower altitudes than VOR and, depending on the facility, may also provide greater reception range. You can set a three-digit frequency code on the ADF receiver. Before you can use the ADF, you must activate it. When activated, the ADF indicator replaces the OBI 2 (NAV 2 indicator) on the instrument panel.

To activate the ADF and set the frequency

1 From the Nav/Com menu, choose ADF.

Flight Simulator displays the ADF dialog box.

2 In the ADF Frequency box, type the frequency you want.

Check Appendix B, "Sectionals, Directories, and Runway Maps," on page 211, for the NDB frequency for each airport.

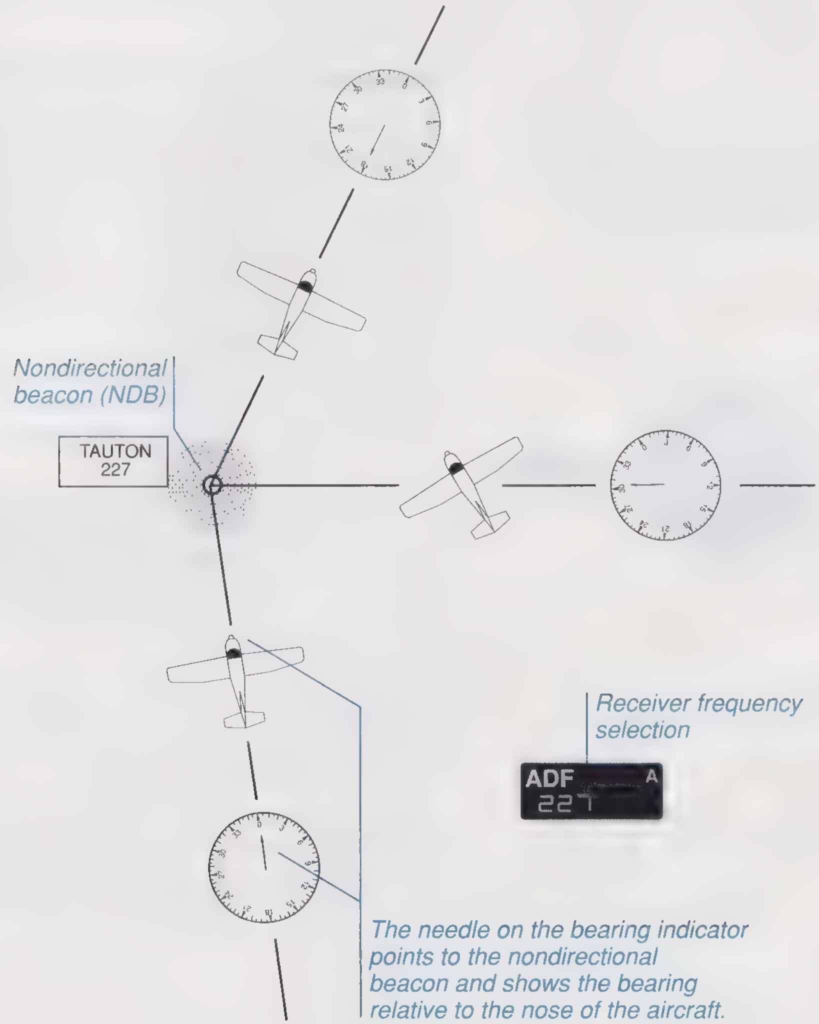
3 Choose the Activate ADF Gauge check box.

4 Choose the OK button.

Once you activate the ADF, you can also use the keyboard (press the A key once for the first digit, twice for the second digit, and three times for the third digit, and then press the PLUS SIGN or MINUS SIGN key), or click the numbers of the ADF on the instrument panel to adjust frequency.

When the ADF receiver is tuned to an NDB, the needle on the omni-bearing indicator points to the station and shows the bearing relative to the nose of the aircraft (the relative bearing). You calculate the magnetic bearing to the station by adding the relative bearing to the aircraft's magnetic heading.

Automatic Direction Finder



Instrument Landing System

The Instrument Landing System (ILS) is a set of navigation systems that direct you to a runway for a safe landing in nearly any kind of visibility conditions. The three main systems involved are:

For information on which airports include ILS, see the airport directories in Appendix B, "Sectionals, Directories, and Runway Maps," on page 211.

Localizer A highly sensitive VOR used on only one radial lined up with the runway. The localizer transmitter is located on the extended runway center line at the far end of the runway. You tune it in on your NAV radio like a normal VOR station, but you don't set the OBI to a radial direction—the direction is set automatically. Needle movement is four times as sensitive as that of a normal VOR station, so you can hold your horizontal course very precisely.

Glide Slope A type of VOR turned in an up and down direction. The glide-slope needle on OBI 1 is used to track the glide slope. This instrument, like the localizer, is very sensitive and deflects from needle up to needle down in 1.4-degree glide-slope variation. The glide-slope transmitter is located alongside the runway at the approach end. Following the glide slope leads you down to the runway at the correct approach attitude.

VHF Marker Beacons Beacons placed on the ground directly below the localizer path at preset distances. They transmit very tight radio beams (on a narrow bandwidth), straight up, so the outer, middle, and inner (OMI) marker-light receiver on the aircraft picks them up when you fly directly over the beacons. This gives you information about the distance to the runway. The marker beacons emit tones related to each marker in the form of dots (short tones) and dashes (long tones) in a unique sequence.

Marker	Tones
Outer marker	Located 4 to 7 miles from the approach end of the runway. The audio signal is a repeating sequence of dashes. The visual indicator is a blue light.
Middle marker	Located 3500 feet, plus or minus 250 feet, from the end of the runway. The audio signal is an alternating sequence of dots and dashes. The visual indicator is an amber light.
Inner marker	Located on the runway. The audio signal is a repeating sequence of dots. The visual indicator is a white light.

The ILS lets you make a precision approach by tracking the localizer and glide slope down to the runway. The approach is precise enough in most cases, given good approach lighting and a lack of obstacles, to guide you down to a decision height of 200 feet above ground level (AGL) one-half mile short of the runway.

Approach Lighting Systems

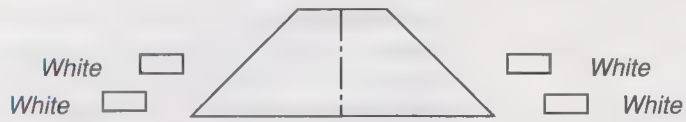
The approach to runway 32 at the Champaign, Illinois airport has all ALS aids and is a good place to practice.

Approach lighting systems (ALS) are visual aids that give you guidance information while you make an approach to a runway. They help you stay lined up horizontally with the runway and guide you down the proper glide slope. These aids are on different runways throughout Flight Simulator.

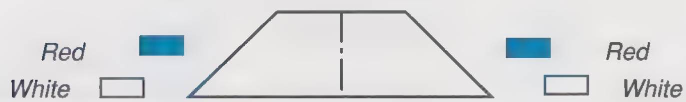
Visual Approach Slope Indicator

Chicago Meigs Field and the Champaign Airport both use VASIs.

The visual approach slope indicator (VASI) uses color-coded lights positioned along the runway near the touchdown point and acts as a visual glide-slope indicator. As you fly toward the runway on your final approach, the lights show different colors for when you are above, below, or on the correct glide slope. The following illustration shows the color codes used to indicate proper glide slope.



Too high (runway looks long)

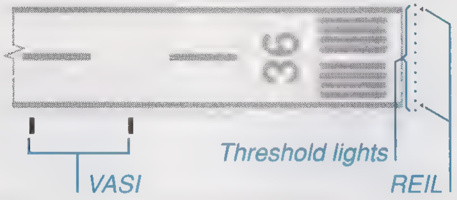


On glide slope

Too low (runway looks short)

Runway End Identifier Lights

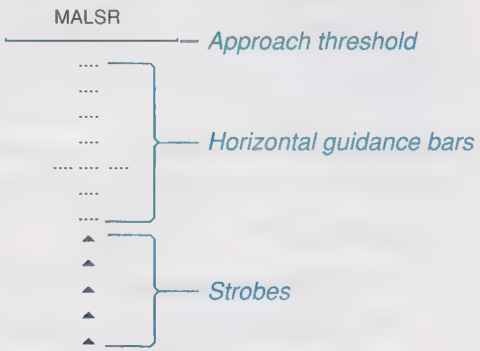
Runway end identifier lights (REIL) are two synchronized flashing lights located laterally on both sides of the runway threshold facing the approach area. They help identify runways that could be confused with surrounding terrain or city lights, and highlight runways under conditions of reduced visibility.



Medium Intensity Approach Lighting System

The San Francisco International, Oakland International, Los Angeles International, John F. Kennedy International, Champaign, Illinois, and Chicago-O'Hare International airports all use MALSRs.

Flight Simulator includes a medium intensity approach lighting system (MALSR) with runway alignment indicator lights (RAIL). The MALSR is one member of a family of approach lighting systems that provide both horizontal and glide-slope information. A row of sequenced strobe lights lined up with the runway flash at two cycles per second. In operation, the strobes resemble tracer shells being fired at the runway. Several rows of steady horizontal lights follow. These guidance bars lead the pilot to the approach threshold for touchdown.



Airport Beacons

You can spot airports at night by their flashing beacons, alternating between green and white. Generally an airport's beacon is on from dusk until dawn. Locations of beacons are shown on the airport runway maps in Appendix B, "Sectionals, Directories, and Runway Maps," on page 211. The symbol for each beacon is a star.

EFIS/CFPD Display

Electronic flight instrument systems (EFIS) include some of the most advanced navigational aids in use today. These systems cover a range of applications and options in modern aircraft. EFIS encompass everything from engine controls and checklists on CRT displays in cockpits to advanced equipment that projects symbology and instrumentation on the pilot's windshield.

One of the most promising new systems is the Command Flight Path Display (CFPD). This display projects a series of images you can follow en route to a very high-frequency omnidirectional range (VOR) station or during an instrument landing system (ILS) approach. A series of rectangles, T-shaped objects, or yellow lines extends out in front of you on the screen. These guides direct your flight path or instrument approach.

When you use EFIS/CFPD, first decide whether you want to lock to ILS For Landing Approach or to VOR And Altitude Tracking. If you lock to ILS For Landing Approach and set NAV 1 to the ILS frequency for your airport, Flight Simulator displays a CFPD that directs you to the runway. On some displays, the CFPD changes color near the runway during an ILS approach. This color change indicates that you have reached decision height—the altitude at which you must decide whether to land or retry your landing attempt. If you lock to VOR And Altitude Tracking, you must set the VOR and altitude.

You can also plot a path from your current location to the requested CFPD and choose the type, density, and range of the visual display.

To use EFIS/CFPD

1. From the Nav/Com menu, choose EFIS/CFPD Display.

   Flight Simulator displays the EFIS/CFPD Display dialog box.

2. To activate the EFIS flight path display, choose the EFIS Master Switch box.

Choose Lock To ILS For Landing Approach if you are nearing an airport and want assistance with landing. Choose Lock To VOR And Altitude Tracking if you want navigational assistance for your destination.

3 Choose Lock To ILS For Landing Approach or Lock To VOR And Altitude Tracking.

If you choose Lock To VOR And Altitude Tracking, you also need to choose either the VOR 1 or VOR 2 option, and set an altitude above ground level (AGL).

4 Choose the Plot Intercepting Path check box if you want to plot a path from your current location to the EFIS frequency you've just set.

5 In the Type box, choose the type of CFPD you want.

The Rectangles option displays rectangles you fly through on your course. The Telephone Poles option displays T-shaped objects you fly over on your course. The Yellow Brick Road option displays yellow plates you fly over on your course.

6 To set the density of the flight path display, choose the Thin, Medium, or Thick option in the Density box.

7 To specify how far the path extends in front of you, choose the Short, Medium, or Long option in the Range box.

8 Choose the OK button.

Air Traffic Control

For more information on the phonetic alphabet, see page 257 in the Glossary.

In a real aircraft, you use the communication radio to tune in ground control, departure control, and approach control when you are taking off, landing, or flying through an air traffic control (ATC) area. First you tune in the Air Traffic Information Service (ATIS) for weather and traffic advisories. ATIS broadcasts are labeled with successive letters from the phonetic alphabet, such as "information ALPHA" or "information BRAVO." Next you initiate radio contact by stating the name of the facility you are calling and then providing your aircraft type, model, or manufacturer, and registration number, followed by your location, ATIS identifier, and intent. For example, if you are contacting approach control at Paine Field from five miles out, you say, "Paine Tower, Cherokee 47852, over Hat Island, at 2000 feet, with information NOVEMBER, inbound for landing."

When you are flying Flight Simulator, you use the Air Traffic Control command on the Nav/Com menu to request permission to take off or land. The ENTER key is your microphone for communicating with the tower.

To turn Air Traffic Control on

- From the Nav/Com menu, choose Air Traffic Control.

To use Air Traffic Control for takeoff

1. Press ENTER.

   Flight Simulator displays the Air Traffic Control dialog box.

2. Choose Request To Take Off, and then choose the OK button.

   Flight Simulator displays the message "[your aircraft identification number] requesting takeoff clearance..." A few seconds later Flight Simulator displays the message "[your aircraft identification number] taxi to runway of your choice and hold short," followed by the word "squawk" and a four-digit number. This is the number to which you should set your transponder transceiver (transponder code, or "squawk code").

3. Set your transponder radio to the code given.
4. Flight Simulator displays a message clearing you for takeoff.

Set your transponder by clicking the transponder digits on the instrument panel or pressing the T key (once for the first number, twice for the second number, and so on), and then pressing the PLUS SIGN or MINUS SIGN key.

To use Air Traffic Control for landing

1. Press ENTER.

   Flight Simulator displays the Air Traffic Control dialog box.

2. Choose Request To Land, and then choose the OK button.

   Flight Simulator displays your request to land, followed a few seconds later by ATC's message clearing you for landing.

Autopilot

On long cross-country flights, you'll find that an autopilot is a good flight aid. It relieves you of the tedious chore of holding a desired altitude and tracking a heading, VOR, or landing approach. This reduces fatigue and lets you devote more time to other flight tasks such as instrument scan, radio communications, or approach preparation. The autopilot is especially helpful for maintaining a specific altitude while flying a powerful aircraft like the Learjet.

The autopilot's wing leveler (a separate system in many aircraft, but integrated with the autopilot in Flight Simulator) keeps the wings as level as possible to prevent you from going into an unexpected turn or roll. The option for stabilizing attitude (pitch

and bank) is also useful in turbulent conditions. With this option turned on, you don't have to keep an eye on the attitude indicator continuously and are less likely to end up in a steep bank or upside down.

Flight controls for the locked functions (ailerons when the wing leveler is turned on, for example) respond sluggishly when the autopilot is turned on. For best results, you should set the autopilot first and align the aircraft with the intended flight path before connecting the autopilot. For example, if you want to lock the altitude and fly at 8000 feet, choose the ALT (Altitude) Hold check box and type 8000 feet, fly to 8000 feet, and then turn on the Autopilot Switch to maintain that altitude. The same principle applies when locking to a heading or VOR radial: set the autopilot first and align the aircraft with the heading you want, and then turn on the Autopilot Switch.

To set the Autopilot

1 From the Nav/Com menu, choose Autopilot.

  Flight Simulator displays the Autopilot dialog box.

Once you connect the autopilot, you'll need to choose the options you want to control.

2 To keep the wings as level as possible, choose the LVL (Wing Leveler) check box.

3 To keep the aircraft from pitching or banking, choose the ATT (Pitch And Bank) Hold check box.

When you choose ALT (Altitude) or HDG (Heading), type the value you want in the corresponding text box.

4 To lock to an altitude, choose the ALT (Altitude) Hold check box, and type an altitude.

5 To lock to the glide slope for a landing, choose the GS (Glide Slope) Hold check box.

6 To lock to the VOR radial, choose the NAV (NAV 1 Heading) Hold check box.

7 To lock to a heading, choose the HDG (Heading) Hold check box, and type a heading.

8 To lock to the ILS and glide slope for an approach, choose the APR (Approach) Hold check box.

9 To lock to a back course and fly directly down the back side of the localizer, choose the BC (Back Course) Hold check box.

10 Choose the OK button.

Once the autopilot is set, turn it on to start tracking the locked functions.

To turn the Autopilot on or off

▶ With the mouse, click the autopilot status indicator on the instrument panel to turn the autopilot on or off.
–or–
With the keyboard, press the Z key.
–or–
From the Nav/Com menu, choose Autopilot, and then, in the Autopilot dialog box, choose the Autopilot Switch to connect or disconnect the autopilot.

Chapter 16 Flight Analysis and Course Tracking

Flight Simulator accelerates your flight training by giving you immediate feedback on your maneuvers, landings, or unsuccessful flights. It also lets you track your aircraft so that you can see how well you are flying a particular course.

This chapter describes the flight-analysis system that charts every phase of a maneuver or landing, the crash-analysis system that helps you determine what went wrong, the instant-replay capability that lets you review your actual performance second by second, and the course-tracking system that lets you plot and follow your course.

Flight-Analysis System

When you are practicing landings and other flight maneuvers, you get a general idea of your actions, but it's impossible to see your exact flight path. Using the flight-analysis system is like having a teacher who explains your strengths and points out your areas for improvement using graphs of your performance. You can see how round your loops were, how good your flare was during a landing, or what your flight path looked like during a stall.

Using Landing Analysis

Remember that the altimeter reflects altitude at mean sea level (MSL) and not absolute altitude, or the actual height of the aircraft above ground level (AGL). For example, at Meigs Field (593 feet MSL) the altimeter reads 693 feet when you are 100 feet above the runway.

Landing Analysis monitors your landing starting at 100 feet above the runway. After you land, a graph evaluates:

- Your flight path to the runway.
- Your vertical velocity at touchdown.

To use Landing Analysis

1. Set up a landing approach.

   It can be straight or in a pattern. You must be more than 100 feet above the runway.

2. From the Options menu, choose Flight Analysis.

   Flight Simulator displays the Flight Analysis dialog box.
3. Choose the Landing Analysis option, and then choose the OK button.
4. Make the landing.

   When you roll to a stop, Flight Simulator displays the Landing Analysis graph.
5. When you have finished reviewing the graph, choose the OK button to resume normal flight.

Using Maneuver Analysis

Maneuver analysis is similar to landing analysis, except that you are analyzing a maneuver, such as a turn or a stall, and it is not triggered by the 100-foot rule. Course recording begins the moment you choose the Maneuver Analysis option and ends when you press the BACKSLASH (\) key.

You can record both ground and air maneuvers. The analysis graph is a two-dimensional display that shows changes in heading, but not changes in altitude.

To use Maneuver Analysis

1. Set up for a maneuver.
2. From the Options menu, choose Flight Analysis.

   Flight Simulator displays the Flight Analysis dialog box.
3. Choose the Maneuver Analysis option, and then choose the OK button.
4. Perform your maneuver.
5. When you have finished the maneuver, press the BACKSLASH (\) key.

   Flight Simulator displays the Maneuver Analysis graph.
6. When you have finished reviewing the graph, choose the OK button to resume normal flight.

Using Crash Detection

When you start Flight Simulator, the Crash Detection feature is automatically set to the Detect Crash And Reset Situation option. This means that Flight Simulator alerts you when you crash, and immediately restarts your situation.

However, you can change this setting. The Crash Detection system includes a graph that shows your flight trajectory and vertical velocity. What better way to determine what caused your crash and to learn from your mistakes?

To use Crash Detection

1. From the Sim menu, choose Crash Detection.

   Flight Simulator displays the Crash Detection dialog box.

2. To review unsuccessful flights, choose the Detect Crash And Show Graph option.
3. Choose the OK button.

You can choose Crash Detection again at any time to change the options. If you want Flight Simulator to disregard crashes, choose the Ignore Crash option.

If you want to see crash graphics on the big screen, choose View Options from the Views menu, and then choose the Full Screen External View check box. Remember to cycle to Spot view by pressing the s key.

If you want more realism when you crash, choose any of the check boxes in the lower half of the dialog box. Choose the Show Aircraft Damage check box and see dynamic crash graphics—the Cessna actually breaks apart! Choose the Off-Runway Crash Realism check box and landing anywhere but on the runway increases your chances of crashing. Choose the Crash When Hit Objects check box and Flight Simulator detects crashes into buildings or mountains.

To resume flying after analyzing a crash

When you choose the Detect Crash And Show Graph option, Flight Simulator displays a Crash Analysis graph after each crash.

- ▶ When you have finished reviewing the graph and analyzing the crash, choose the OK button to resume normal flight.

Using Instant Replay

As you fly, Flight Simulator records your progress through the air. You can play back the last 50 seconds of flight at any time and see yourself in action. Watch as you make a perfect landing in your Learjet but then roll off the end of the runway because your speed was too high, or check out a slow-motion replay of your sailplane soaring to new heights.

To view an instant replay

1. From the Options menu, choose Instant Replay.

   Flight Simulator displays the Instant Replay dialog box.

2. In the Replay Final Seconds box, enter the number of seconds you want to view.

   Flight Simulator records up to 50 seconds of flight. The number of seconds currently available for replaying is displayed under Available Replay Seconds.

3. Under Replay Speed (%), enter the percentage of normal speed at which you would like to view the replay.

   The speed at which the replay was recorded is 100%; 50% is half as fast, 200% is twice as fast, and so on.

4. Choose the Repeat Replay check box if you want the instant replay to restart automatically each time it finishes.

   Press ESC at any time to stop the replay loop.

5. Choose the OK button to start instant replay.

   When the replay is finished, Flight Simulator displays the Instant Replay dialog box again.

6. Choose the OK button, and then press the P key to resume normal flight.

Course-Tracking System

Course tracking lets you record your aircraft's course and display it against the scenery. As you fly, the aircraft's position is recorded at preset intervals. When you display your course, Flight Simulator draws red line segments between the recording points and displays them behind your aircraft so that you can see your flight pattern. You can record and display a course at the same time.

The Course-Tracking feature is great if you want to see how well you fly a standard traffic pattern or want to watch your aircraft as you weave among the buildings in the Chicago skyline.

To track your course

1. From the Options menu, choose Flight Analysis.

   Flight Simulator displays the Flight Analysis dialog box.

2. Choose the Course Tracking option.

To see your course while you record, choose both the Record Course check box and the Display Course check box, and then watch from Tower view.

3. Choose the Record Course check box to record your course.

4. Choose a track length. You can choose Short, Medium, or Long.

   This option determines the number of line segments that will be displayed. Short displays 5 line segments, Medium displays 15 line segments, and Long displays 30 line segments. If you are using a slower computer, choose Short.

Memory for storing track length is limited. The oldest part of your course is erased as you run out of memory.

5. Choose a resolution. You can choose Fine, Medium, or Coarse.

   If you are flying a long distance, such as cross-country, choose Coarse. If you are performing precision maneuvers, choose Fine.

6. Choose the OK button.

You can display your course after flying.

To display your course

To clear a recorded course, choose Flight Analysis from the Options menu, choose the Clear Recorded Course check box, and then choose the OK button.

1. From the Options menu, choose Flight Analysis.

   Flight Simulator displays the Flight Analysis dialog box.

2. Under Course Tracking, choose Display Course, and then choose the OK button.

   Flight Simulator displays your course in the View 1 and Map View windows. In the View 1 window you can see your course from Tower view if you are near an airport, or by looking out the rear of the aircraft in Cockpit view, or by setting the spotter plane ahead of you in Spot view.

Chapter 17 Logbook

Pilots keep track of the hours they fly by recording them in a logbook or pilot log. Flight Simulator can maintain logbooks for any number of pilots.

Using a Logbook

The Flight Simulator logbook is an abbreviated version of an official pilot logbook. It includes the date, type of aircraft, number of flight hours, and any comments you want to record. An official logbook usually includes additional information such as aircraft category (airplane, rotorcraft, glider, lighter-than-air) and class (single-engine, multi-engine), as well as aircraft type and identification numbers. Other data you'd find in an official logbook might include more details on the flight route, the conditions during a flight, and the type of flight (for example, cross-country or solo for student pilots).

Flight Simulator automatically determines which aircraft you are flying and whether you are flying during the day or night or on instruments. The date of the flight is taken from your computer's clock. Day or night logging is based on your flying time before or after sunset using the instrument panel clock. Instrument logging is based on flying time when you have no visual references—for example, when you are flying inside clouds or when the View 1 and View 2 windows are closed. Flight Simulator totals your day, night, and instrument hours and then uses these figures to calculate the total hours recorded.

If you are flying from one destination to another, Flight Simulator records your flight. However, if you change situations, Flight Simulator only records your last situation and you must enter the unrecorded information manually.

Note The Flight Simulator logbook does not record aircraft changes during a flight. For example, if you fly the Cessna for 10 minutes, choose Aircraft from the Options menu, change to the Learjet, and then fly for another 10 minutes, Flight Simulator records this as one 20-minute Learjet flight.

To start logging time in a new logbook

Flights of less than six minutes are not recorded in the logbook.

1. From the Options menu, choose Logbook.

   Flight Simulator displays the Standard Pilot Logbook dialog box.

2. Choose the Create Logbook button.

   Flight Simulator displays the Create Logbook dialog box and proposes an initial logbook for you, called Standard Pilot Log. You can change the name if you like by simply typing a new one.

3. Choose the OK button.

   Flight Simulator displays the Standard Pilot Logbook dialog box.

You can have different logbooks for each aircraft. Before you start logging time, make sure you choose the right logbook for your trip.

4. From the list, choose Standard Pilot Log (or the logbook you want).
5. Choose the Log Flight Time check box.

   This is the way to manually log time for a specific flight.

   During Setup, you may have already chosen the Log Flight Time check box. If so, Flight Simulator automatically logs your time as soon as you start flying.

If you did not choose the Log Flight Time check box during Setup and want to start logging time automatically each time you start flying, you can do so now. Choose Preferences from the Options menu, and then, in the General Preferences dialog box, choose the Log Flight Time check box.

6 Choose the OK button.

Flight Simulator starts logging in your flight time.

Note When you choose the Log Flight Time check box, Flight Simulator restarts the timer that records your flight time each time you add an entry. For example, if you fly for 10 minutes, add a logbook entry while in the air, and then continue to fly for 10 more minutes and add another entry, Flight Simulator records this as two 10-minute flights.

Working with a Logbook

You can also review and edit your logbook. The logbook is stored as a standard ASCII text file.

To add an entry to a logbook

1. From the Options menu, choose Logbook.

   Flight Simulator displays the Standard Pilot Logbook dialog box.
2. From the list, choose the logbook to which you want to add an entry.
3. Choose the Edit Logbook button.

   Flight Simulator displays your logbook.
4. Choose the Add Entry button.

   Flight Simulator displays the Add Logbook Entry dialog box.
5. Type the new entry (Flight Simulator automatically logs the date of your flight and the aircraft type—you can add comments or information on the duration of the flight), and then choose the OK button.
6. Choose the Save button to save your changes and close the logbook.

To review and edit a logbook

1. From the Options menu, choose Logbook.

   Flight Simulator displays the Standard Pilot Logbook dialog box.

2. From the list, choose the logbook you want to edit.
3. Choose the Edit Logbook button.

   Flight Simulator displays your logbook.

4. Choose the entry you want to edit, and then choose the Edit Entry button.

   Flight Simulator displays the Edit Logbook Entry dialog box.

5. Change the information you want by typing in the appropriate boxes, and then choose the OK button.

   The new information is displayed in your logbook.

6. Choose the Save button to save your changes and close the logbook.

If you change your mind and want your original logbook back, choose the Cancel button.

To delete an entry from a logbook

1. From the Options menu, choose Logbook.

   Flight Simulator displays the Standard Pilot Logbook dialog box.

2. From the list, choose the logbook from which you want to delete an entry.
3. Choose the Edit Logbook button.

   Flight Simulator displays your logbook.

4. Choose the entry you want to delete.
5. Choose the Delete Entry button.

   Flight Simulator displays the message: "Are you sure you want to delete the logbook entry?"

6. Choose the OK button if you want to delete the entry.
   –or–
   Choose the Cancel button if you don't want to delete the entry.
7. Choose the Save button to save your changes and close the logbook.

If you change your mind after you delete an entry, choose the Cancel button. When you open the logbook again, the entry will be displayed.

To change the name (and filename) of a logbook

1. From the Options menu, choose Logbook.

   Flight Simulator displays the Standard Pilot Logbook dialog box.
2. From the list, choose the logbook whose name you want to change.
3. Choose the Change Information button.

   Flight Simulator displays the Change Logbook Information dialog box.
4. Type a new name (and filename, if you want) for the logbook, and then choose the OK button.
5. Choose the OK button again to save your changes and close the logbook.

To delete a logbook

You cannot delete the logbook in which Flight Simulator is automatically logging your flight time (Standard Pilot Logbook).

1. From the Options menu, choose Logbook.

   Flight Simulator displays the Standard Pilot Logbook dialog box.
2. From the list, choose the logbook you want to delete.
3. Choose the Delete Logbook button.

   Flight Simulator displays the message: "Are you sure you want to delete the selected logbook?"
4. Choose the OK button if you want to delete the logbook.
   –or–
   Choose the Cancel button if you don't want to delete the logbook.
5. Choose the OK button again to resume normal flight.

Entertainment

Before you try these games, make sure you're familiar with the basics of flight. For information on flight instruments and controls, see "Instrument Panel and Radio Stack" on page 43, "Primary Flight Controls" on page 53, and "Secondary Flight Controls" on page 61.

Flight Simulator includes an entertainment section so that you can fly just for the fun of it. When you choose the Entertainment command from the Options menu, it's time to relax and play games while you fly. Test your skills and put your sense of precision to the test in an amusement park in the sky.

Chapter 18, "Dual-Player Flight," lets you share the Flight Simulator airways with a friend. Follow the smoke trail ahead or fly side by side.

Chapter 19, "Formation Flying and Crop Duster," describes two games designed for the Cessna. Results with other aircraft may be less than optimal, but Flight Simulator does allow you to fly any aircraft in any environment.

Chapter 20, "EFIS Navigational Challenges," gives you the chance to use the Electronic Flight Information System (EFIS) for fun. A series of on-screen graphics directs you to both airports and runways.

Chapter 18 Dual-Player Flight

One fun source of entertainment in Flight Simulator is the Dual-Player option. You and a friend can send and receive messages while you fly together using two separate computers. You can share your impression about your performance in the air or talk about the scenery that surrounds you. Using the Dual-Player option adds a whole new dimension to flying and takes the solitary element out of your in-flight experience.

Connecting Two Computers

Before you and a friend can fly in tandem using the Dual-Player option, you must connect your computers. You can connect two computers together directly if they are in the same room, or use the phone lines and modems if the computers are in separate locations.

Establishing a Direct-Cable Connection

For more information on null modem cables, see "Dual-Player" on page 200.

You can connect two computers in the same room for dual-player flight by using a null modem cable. Plug the DB25 ends of the cable (these are rectangular in shape) into the appropriate ports in the backs of both computers, and then establish communications.

To establish a direct-cable connection and start dual-player flight

1. From the Options menu, choose Entertainment.

   Flight Simulator displays the Entertainment dialog box.

2. From the list, choose the Dual-Player option, and then choose the OK button.

   Flight Simulator displays the Dual-Player dialog box.

3. Choose the Communications Preferences button.

   Flight Simulator displays the Dual-Player Communications Preferences dialog box.

4. Choose the COM Port option, and then choose a communications port.

5. Choose the Baud Rate option, and then choose a baud rate.

   Depending on the baud rate your modem can handle, choose 300, 1200, or 2400. Flight Simulator runs most efficiently at baud rates lower than 9600.

In dual-player flight, both players must communicate at the same baud rate.

6. Make sure the Wait For Ring check box is turned off.
7. In the Modem Initialization String box, delete all text by pressing the BACKSPACE key until the box is empty, and then press the ENTER key.
8. Choose the OK button to return to the Dual-Player dialog box, and then choose the Direct Connect button to begin communications.

   Flight Simulator displays the message "Connected!" in the lower-left corner of your view window and begins sending communications, such as latitude and longitude, between computers.

To return to normal flight

▶ From the Dual-Player dialog box, choose the Quit Dual-Player button.

Establishing a Modem Connection

If you and your flying companion live some distance from each other, you can use telephone modems to communicate. If you are using an external modem, a cable connects the modem to one of the computer's COM ports. Flight Simulator works best if this cable has all the serial "handshaking" circuits connected. If you aren't sure if the cable on your computer has these connections, consult the documentation that came with your cable or contact the dealer who supplied you with it. If you are using an internal modem, you don't have to worry—there is no cable between the computer and the modem.

To establish a modem connection using Hayes-compatible modems and start dual-player flight

1. From the Options menu, choose Entertainment.

   Flight Simulator displays the Entertainment dialog box.
2. From the list, choose the Dual-Player option, and then choose the OK button.

   Flight Simulator displays the Dual-Player dialog box.
3. Choose the Communications Preferences button.

   Flight Simulator displays the Dual-Player Communications Preferences dialog box.
4. Choose the COM Port option, and then choose a communications port.

In dual-player flight, both players must communicate at the same baud rate.

5 Choose the Baud Rate option, and then choose a baud rate.

Depending on the baud rate your modem can handle, choose 300, 1200, or 2400. Flight Simulator runs most efficiently at baud rates lower than 9600.

6 Your flying companion should now choose the Wait For Ring option and wait for your call to come through.

7 As the person placing the call, choose the Telephone Number To Dial option and type your flying companion's telephone number.

8 Choose the OK button to return to the Dual-Player dialog box, and then choose the Dial And Connect button to begin communications.

When a connection has been established, Flight Simulator displays the word "Connected" in the message box. You can now communicate with your flying companion.

To establish a modem connection using non-Hayes-compatible modems and start dual-player flight

1 From the Options menu, choose Entertainment.

Flight Simulator displays the Entertainment dialog box.

2 From the list, choose the Dual-Player option, and then choose the OK button.

Flight Simulator displays the Dual-Player dialog box.

3 Choose the Communications Preferences button.

Flight Simulator displays the Dual-Player Communications Preferences dialog box.

4 Choose the COM Port option, and then choose a communications port.

In dual-player flight, both players must communicate at the same baud rate.

5 Choose the Baud Rate option, and then choose a baud rate.

Depending on the baud rate your modem can handle, choose 300, 1200, or 2400. Flight Simulator runs most efficiently at baud rates lower than 9600.

6 Your flying companion should now choose the Wait For Ring option and wait for your call to come through.

7 As the person placing the call, type an initialization string in the Modem Initialization String box.

This sets the modem. Consult your modem documentation for information on which initialization string you should type.

8 Choose the Telephone Number To Dial option and type your flying companion's telephone number.

9 Choose the OK button to return to the Dual-Player dialog box, and then choose the Dial And Connect button to begin communications.

Flight Simulator begins sending communication, such as latitude and longitude, between computers.

Flying Together

If you want to make your dual-player flights more realistic, choose the Other Plane Collision option in the Dual-Player dialog box. When you turn on this option, you must be careful—if you brush the other aircraft's wingtips, you could crash.

Once you connect your computers, you and your flying companion are ready to begin dual-player flight.

To position both aircraft for dual-player flight

1 From the Options menu, choose Entertainment.

Flight Simulator displays the Entertainment dialog box.

2 From the list, choose the Dual-Player option, and then choose the OK button.

Flight Simulator displays the Dual-Player dialog box.

If you and your flying companion take off from the same airport, you can skip step 4. Finding each other will be easy.

3 Look for the other aircraft's latitude and longitude (or north and east coordinates for Flight Simulator 4.0-compatible files) next to Other Plane Location, and then choose the Cancel button.

4 From the World menu, choose Set Exact Location and type the same coordinates as those displayed in the Dual-Player dialog box, or coordinates that will place you near your flying companion's aircraft.

There's a quick way to catch up with your flying companion. First make sure you are both on the ground or both in the air (to avoid crashing), and then press CTRL+SPACEBAR.

5 From the Options menu, choose Entertainment again.

Flight Simulator displays the Entertainment dialog box.

6 Choose the Dual-Player option, and then choose the OK button.

Flight Simulator displays the Dual-Player dialog box.

7 Choose the Send Aircraft option to send information about your aircraft to your flying companion's computer so that Flight Simulator can display your aircraft accurately.

Your flying companion should do the same.

6 Choose the Other Plane Color option to change the color of the other aircraft's fuselage so it is more clearly visible.

Now you should be able to locate the other aircraft but if you still can't see it, use Track view. Track view, which is only available in dual-player flight, lets you track the other player's aircraft from your cockpit.

To use Track view to locate your flying companion's aircraft

You can also use the keyboard to cycle quickly to Track view. Simply press the s key.

1 From the Views menu, choose View Options.

  Flight Simulator displays the View Options dialog box.

2 Choose a window (View 1 or View 2).

3 Choose the View box, and then choose Track.

4 Choose the Titles On Windows check box.

Use Track view to find the other player's aircraft, but switch back to Cockpit view to look straight out your cockpit as you fly.

  When you choose the Titles On Windows check box, Flight Simulator displays the view name (Cockpit, Tower, Track, or Spot) in the upper-left corner of your screen.

5 Choose the OK button.

  Flight Simulator displays your flying companion's aircraft as seen from your cockpit.

Sending and Receiving Messages

When you are flying with another person in dual-player flight, you can actually talk back and forth to compare notes on your location, your instrument readings, the weather, or whatever you want.

To send and receive messages

1 From the Options menu, choose Entertainment.

  Flight Simulator displays the Entertainment dialog box.

2 From the list, choose the Dual-Player option, and then choose the OK button.

  Flight Simulator displays the Dual-Player dialog box.

From now on, you can switch from dual-player flight to the message box by pressing the ZERO key on the keyboard (not the keypad).

3 Choose the Send Message button.
–or–
Press the ZERO (0) key on the keyboard (you can also press SHIFT+ESC).

Flight Simulator displays a small area along the bottom of your view window where you can type your message.

To hear a beep each time you receive a message, first make sure that you turn on Sound on the Sim menu. Choose Preferences from the Options menu, choose the Sound button, and then choose the Cockpit Sounds check box.

4 Type your message (limit it to the space available in the message box).

5 Press the ENTER key to send your message and continue dual-player flight.

When you receive messages from the other player, Flight Simulator automatically displays them on the bottom line of the message box. If you want to respond to the message, press the ZERO key, type your message, and then press ENTER to send your message and continue dual-player flight.

You can close the message window by pressing ESC. It will automatically open and display new messages when your flying companion sends them.

Tips for Dual-Player Flight

Because an aircraft is relatively small, and the field of view is only a small portion of the three-dimensional Flight Simulator world, it can be difficult at first to find and keep track of the other player's position. The more you practice, the easier it gets.

Here are some tips on how to keep track of your companion's aircraft and make dual-player flight more fun. Soon, both of you will be as at home in the sky as a couple of birds.

From the Views menu, choose View Options, choose the Titles On Windows check box, and then choose the OK button. Press the s key to cycle to Track view.

- Use Track view (only available in dual-player flight) to find your companion's aircraft. Observe the scenery behind the other plane to help you determine where it is in relationship to your aircraft. Display a second 3-D window in Cockpit view to broaden your perspective and keep your companion in view at all times. Try flying a circle around the other player's aircraft, or try passing it just for fun.
- Ask your flying companion to choose the Smoke System command from the Sim menu so you can quickly locate his or her aircraft by its smoke trail.

Press SHIFT+TAB to display the ADF on the instrument panel.

- You can choose the ADF Track Other Plane option in the Dual-Player dialog box to track your flying companion with the automatic direction finder (ADF) gauge. If you display the ADF gauge, and set it to 000, its needle will point to the location of the other player's aircraft. For example, if the other plane is on

your right, the needle will point to 9 on the ADF. You can also use the ADF with the distance measuring equipment (DME) to find out the other aircraft's location and distance from your aircraft. For example, if you set the ADF to 001, and the other aircraft is on your right, the needle on the ADF gauge will point to 9 and the DME will display the other plane's distance from yours.

- It's helpful if both players agree to fly within a relatively small area that has prominent landmarks. For example, the Chicago skyline includes the John Hancock Building and the Sears Tower, two large buildings that you can quickly locate from the air. If you both stay within this area, sighting each other will be easy, especially if you use the landmarks as guides and send messages to communicate where you are and what you are doing. Use the map to locate landmarks if you get too far away from your companion.
- If both players choose the Autopilot Lock To Other Plane option in the Dual-Player dialog box, then turn on the Autopilot command on the Nav/Com menu and set the ALT (Altitude) Hold option to the same level, it will be easier to find each other. You may have to change views, but at least you know you will both be at eye level, as long as you don't do aerobatic stunts. One good way to locate your flying companion is to bank fairly hard and fly in a circle. You can also use the zoom controls to zoom out (press the MINUS SIGN key) and widen your field of vision.
- If one player gets too far ahead of the other, there are several solutions.

  First make sure you are both on the ground or both in the air (to avoid crashing), and then press CTRL+SPACEBAR. You'll catch up in a hurry.

  Choose Slew from the World menu or use the slew keys to catch up with your flying companion.

  Choose Set Exact Location from the World menu to synchronize your location.

  Press the P key to pause your simulation while the other player catches up.

Once you are adept at locating each other in a restricted area, it should be easy to stay in contact over the course of a long cross-country flight. Keep the other aircraft in sight by scanning the airways around you and take turns impressing each other with aerobatic maneuvers as you cruise the skies. Most importantly, don't get so wrapped up in looking for your flying companion that you forget to watch where you are going!

Chapter 19 Formation Flying and Crop Duster

This chapter describes the games included in Flight Simulator. In Formation Flying, you fly through a series of obstacles and maneuvers following a computer-controlled aircraft. Flying in the other plane's smoke trail is a challenge. In Crop Duster, you try to cover a field using the least amount of spray possible.

Formation Flying

Flight Simulator is even more fun when you're flying with another aircraft. The goal of formation flying is to follow the leader, keeping the aircraft ahead of you in sight and staying on its tail through a series of challenging maneuvers. The visual effects can be impressive, especially against a scenic backdrop.

To start formation flying

1. From the Options menu, choose Entertainment.

   Flight Simulator displays the Entertainment dialog box.
2. From the list, choose the Formation Flying option, and then choose the OK button.

   Flight Simulator displays the Formation Flying dialog box.
3. From the Flying In Formation list, choose a situation, and then choose the OK button.

In these situations, you fly around and over buildings, under bridges, and across cities, following another aircraft's smoke trail. If you get too far behind, press SPACEBAR to catch up. If your aircraft crashes, the game ends. If you want to start over, choose another formation flying situation and decide on a course.

To return to normal flight

- From the Options Menu, choose Normal Flight.

Crop Duster

In this game, you are flying a single-engine crop-dusting plane over a flat rectangular field. There's not a house within miles. The goal is to cover the field with spray—avoiding obstacles at the end of the field—before the timer counts down to zero. If you want a better score, turn the spray off as soon as you reach the end of the field.

To start crop dusting

1. From the Options menu, choose Entertainment.

   Flight Simulator displays the Entertainment dialog box.

2. From the list, choose the Crop Duster option, and then choose the OK button.

   You start out on a short runway in the middle of miles of green farmland. Take off and point the nose of your aircraft toward the field just ahead and to your right. When you reach the field, start spraying the crops below.

To turn the spray on or off

▶ Press I.

You can watch the spray covering the field. Your score reflects how completely you covered the field with spray, how much of your spray missed the field, and how much time you took.

To return to normal flight

▶ From the Options menu, choose Normal Flight.

Chapter 20 EFIS Navigational Challenges

For more information on the EFIS/CPFD system, see "EFIS/CFPD Display" on page 142.

Electronic Flight Information Systems (EFIS) include some of the most advanced navigational aids in use today. These systems include everything from checklists on CRT displays to advanced equipment that projects images on the aircraft's windshield. Flight Simulator makes these complicated systems fun when you choose the Entertainment command from the Options menu.

Using EFIS Navigational Challenges

Flight Simulator includes a number of scenarios for EFIS entertainment. Each places you on an approach path to an airport. You don't need to turn EFIS on or set any options.

For more information on the ILS and ILS approaches, see "Approach Lighting Systems" on page 140.

There are two sets of challenges. In the first set, you use EFIS during ILS approaches and landings. In the second set, you use EFIS navigation along a VOR. Increase your skills and have fun—try them all!

ILS Approaches and Landings

Normally it's important to pay close attention to all of these navigation systems, but with Flight Simulator's EFIS Navigational Challenges, all you have to do is make your aircraft "go through the hoops" and your approach is as good as, or better than, most instrument pilots could hope for—and it's easy!

An ILS is a set of navigation systems that direct you to a runway for a safe landing in all kinds of visibility conditions. The four main systems involved are:

- A localizer—a highly sensitive VOR used on only one radial lined up with the runway
- A glide slope—a type of VOR turned in an up/down direction
- A set of VHF marker beacons—beacons placed on the ground directly below the localizer path at preset distances
- Approach lights—lights on the ILS runway to provide for transition from instrument to visual flight

EFIS Navigation Along a VOR

The challenge is to keep the needle in the OBI centered and fly to your destination.

During the VOR tracking challenges, you fly your aircraft along a selected VOR and keep it aligned with the VOR. You have three visual references: the scenery outside your window; the EFIS display (centering your aircraft on the display keeps you on course); and the omni-bearing indicator (OBI). Just fly through the hoops and you automatically track the VOR perfectly. As a bonus, your altitude is "spot on" with no drift whatsoever!

To choose an EFIS navigational challenge

1. From the Options menu, choose Entertainment.

   Flight Simulator displays the Entertainment dialog box.

2. From the list, choose EFIS Navigational Challenges, and then choose the OK button.

   Flight Simulator displays the EFIS Navigational Challenges dialog box.

3. Choose the scenario you want to fly (either an ILS approach or a navigational challenge cruising along a VOR), and then choose the OK button.

   Your challenge begins!

Changing EFIS Display Options

You can change EFIS display options—such as the type of flight-path display, density, and range—at any time.

To change EFIS display options

1. From the Nav/Com menu, choose EFIS/CFPD Display.

   Flight Simulator displays the EFIS/CFPD Display dialog box.

2. To turn on the EFIS flight-path display, choose the EFIS Master Switch.

3. In the Type box, choose the type of CFPD you want.

   The Rectangles option displays rectangles you fly through on your course. The Telephone Poles option displays T-shaped objects you fly over on your course. The Yellow Brick Road option displays yellow plates you fly over on your course.

4. To set the density of the flight-path display, choose the Thin, Medium, or Thick option in the Density box.

5. To specify how far the path extends in front of you, choose the Short, Medium, or Long option in the Range box.

6. Choose the OK button.

Getting the Most from Flight Simulator

This section covers Flight Simulator's special features. Now that you're an accomplished pilot, you're ready to add some finesse to your flying repertoire. Watch your aircraft's fuel level to determine when to switch tanks during long flights. Fine-tune your flights with adjustments to your instruments and enhance your daredevil adventures with realistic effects. Then put everything together and take some breathtaking trips.

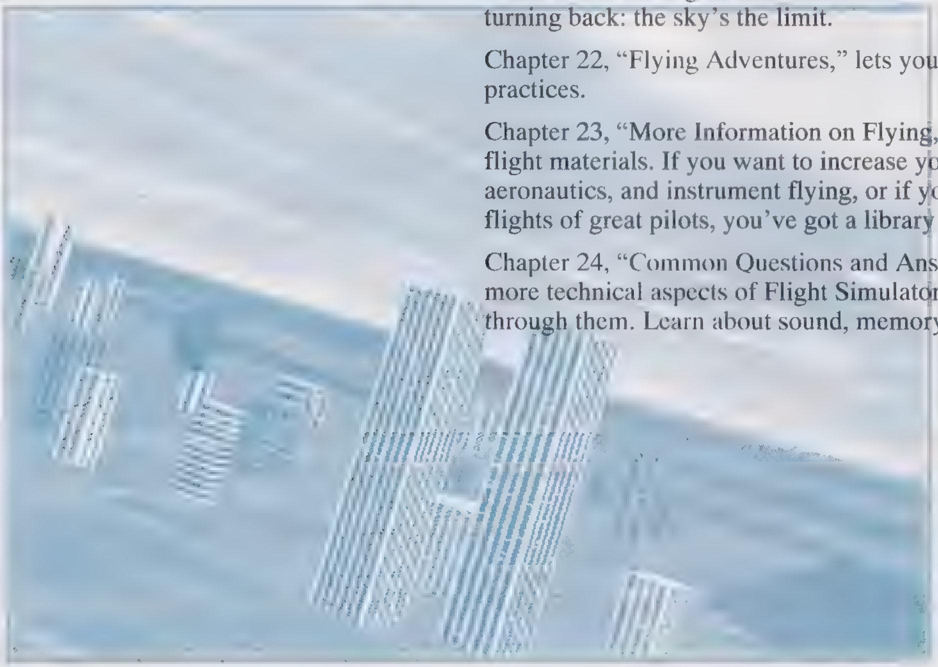
If that's not enough, become a total flying aficionado by reading reference books on aerodynamics and biographies of famous flyers. Know the answers to your friends' questions before they can even pose them.

Chapter 21, "Special Features," explains the more intricate and realistic instruments and effects that Flight Simulator offers. After you read this chapter, there is no turning back: the sky's the limit.

Chapter 22, "Flying Adventures," lets you use all your Flight Simulator skills in fun practices.

Chapter 23, "More Information on Flying," offers you an extensive bibliography of flight materials. If you want to increase your knowledge of flying techniques, aeronautics, and instrument flying, or if you want to discover more about the historic flights of great pilots, you've got a library of reference materials at your disposal.

Chapter 24, "Common Questions and Answers," anticipates your questions on the more technical aspects of Flight Simulator and helps you to troubleshoot your way through them. Learn about sound, memory, video drivers, and display speed.



Chapter 21 Special Features

If you need a definition or explanation of a term, check the Glossary on page 251

As your skills as a pilot improve, you can make adjustments so that your Flight Simulator experience becomes more and more realistic. Once you know what you are doing, you'll fine-tune the elevator trim, compensate for gyroscopic precession, plan ahead for fuel stops, set the mixture control to rich at takeoff, and take care of various other details that are all part of flying an aircraft.

As well as added realism, Flight Simulator offers fun features so that you can record and replay your flights. Create situations that you can use over and over again to practice a certain skill, or take videos and photographs to keep a record of your flights.

Two other handy features include pausing flight time when you are busy with something else but don't want to quit Flight Simulator, and checking simulator information at a glance.

Making Flying More Real

For more realistic flights, turn off the Auto Coordination command on the Sim menu. You must then control the rudder and ailerons separately, as in a real aircraft. For more information, see "Auto Coordination" on page 52.

When you're confident about your flying skills, it's time to push yourself a step (or two, or three) further and make your experience in the cockpit as real as possible. This is the way to get the most from Flight Simulator and to dramatically increase your knowledge of flying.

Flight-Control Realism and Reliability

As a pilot, there are a lot of things to think about and many adjustments to make as you fly. When you encounter certain conditions, you must always compensate by using the proper instruments and controls. As your knowledge grows, so does your ability to fine-tune your flight.

When you first start Flight Simulator, your aircraft is solid and steady so that you can quickly learn how to fly. Now that you're a seasoned pilot, you can add challenges to your flying by changing the realism and reliability options.

The Realism And Reliability command on the Sim menu lets you move to a more detailed level of flight and tests your ability to hold steady as you divide your attention between a multitude of tasks. Add all the realistic touches that you want. Other commands on the Sim menu that increase realism are the Engine And Fuel command, the Sound command, and the Smoke System command.

To make your flights more real

1. From the Sim menu, choose Realism And Reliability.

   Flight Simulator displays the Realism And Reliability dialog box.

2. Under Flight Control Realism, drag the slider or press R+ the arrow keys to choose the degree of realism you want.

   Easy decreases flying difficulty while Realistic forces you to deal with realistic and challenging conditions.

3. Under Aircraft Reliability, drag the slider or press A+ the arrow keys to choose the degree of reliability you want.

   Unreliable makes your aircraft harder to handle and forces you to use your flying skills, while Reliable makes your aircraft a stable and stalwart flying machine.

4. You can also choose from a number of detailed options to decrease the reliability and, consequently, increase the realism of your flying experience.

   - Choose the Elevator Trim check box, and then use the elevator trim indicator on the instrument panel to neutralize pressure on the elevator. If you don't trim properly, the elevator will drift and you'll have to apply constant pressure on the yoke.
   - Choose the Gyro Drift check box to see random drift in the heading indicator or directional gyro. Use the magnetic compass to recalibrate.
   - Choose the Airframe Damage From Stress check box to make your aircraft react realistically when you exceed the manufacturer's performance specifications.
   - Choose the Engine Stops When Out Of Fuel check box and it'll be up to you to keep your aircraft's tanks full.
   - Choose the Instrument Lights check box and you'll have to turn on the instrument-panel lights when it gets dark outside.
   - Choose the Lights Burn Out check box and watch individual instrument lights burn out from time to time, especially if you leave the instrument panel lights on during the day.
   - Choose the Fuel Tank Selector check box, and change fuel tanks manually. To make sure you keep track of the fullest tank as you fly, choose Engine And Fuel from the Sim menu.

For more information on calibrating the directional gyro, see "Standardized Instrument Cluster" on page 45.

For more information on fueling your aircraft, see "Engine And Fuel" on page 172.

For information on flight instruments and controls, see "Instrument Panel and Radio Stack" on page 43.

5 You can also choose to increase Prop Propulsion Realism. This makes the interplay between the throttle, propeller, and mixture controls more realistic.

- Choose the Fast Throttle check box if you want a faster response from the throttle.
- Choose the Prop Advance option, and then choose Fixed Pitch to fix the propeller pitch, Automatic if you want Flight Simulator to adjust the pitch as you fly, or Manual to change propeller pitch and regulate engine rpm manually as you use the propeller control on the instrument panel.
- Choose the Mixture Control check box, and then use the mixture control on the instrument panel to manually control the fuel-to-air ratio while you watch the exhaust, gas, and temperature (EGT) gauge.
- Choose the Magnetos check box, and then choose Engine And Fuel from the Sim menu to set the proper magnetos. You can also turn the magnetos on and off from the instrument panel.

6 If you are flying the Learjet, you can choose Jet Propulsion Realism, and then choose the Flameout check box for flameout at higher altitudes.

Be aware that this option causes the Learjet's engines to fail.

7 Choose the OK button to return to Flight Simulator.

Engine and Fuel

You can turn the engines on or off, estimate how much fuel is in your tanks, and choose which tank to use. You can also turn the engine sounds on or off.

To turn the engines on or off

1 From the Sim menu, choose Engine And Fuel.

Flight Simulator displays the Engine And Fuel dialog box.

2 Under Magnetos, choose the engine you want, and then choose which magnetos you want to fire.

The normal position for magnetos is Both or Start. If you choose the Left or Right option, only those magnetos will fire.

3 Under Engine Controls, choose the engine you want.

If you are flying a single-engine aircraft, only one engine is available.

When you fly the Learjet, the Engine And Fuel dialog box changes. Under Starters (instead of Magnetos), you choose the engine you want, and then choose Off, Start, or Gen. For more information on the Learjet engine switch, see "Instruments for the Learjet" on page 28.

4. Choose the Adjust All Engines check box to set which engine or engines are affected by the throttle, mixture, and propeller controls.

   You can also adjust individual controls, such as throttle, mixture, and propeller, from the instrument panel.

5. Choose the OK button.

To choose a fuel tank and fill it

To fill your aircraft's tanks manually, choose Realism And Reliability from the Sim menu, and then choose Fuel Tank Selector. If the auxiliary tanks are not available for fueling, it is because there are none on your aircraft.

1. From the Sim menu, choose Engine And Fuel.

   Flight Simulator displays the Engine And Fuel dialog box.

2. Choose the Fuel Selector you want.

   You can choose both tanks, the left tank, the right tank, or one of the auxiliary tanks.

3. Under Fuel Level, choose the tanks you want to fill, and then type in the amount of fuel, or type **100** in the % (percent) column to fill the tanks completely.

   When you type in a number of gallons, Flight Simulator automatically adjusts the percent (of full tank) and the pounds figures to the correct amounts. Note that 1 U.S. gallon (3.785 liters or 0.833 Imperial gallon) weighs 6 pounds (approximately 2.73 kilograms). Although internal values for metric conversion are correct, sometimes Flight Simulator rounds off display values to the nearest whole number.

Choose Preferences from the Options menu, choose the Country button, and then, under Units of Measure, choose Metric to display liters instead of gallons and kilograms instead of pounds.

4. Choose the OK button.

To turn sounds on or off

You can also turn sound on or off in Flight Simulator by pressing the Q key.

- From the Sim menu, choose Sound.

  A check mark beside the command name indicates that sound is turned on. Choose the command again to turn sound off.

If you want to turn off engine sounds only, choose Preferences from the Options menu, choose the Sound button, and then choose the Engine Sounds check box.

Smoke System

For information on dual-player flight, see "Dual-Player Flight" on page 158.

Another way to add realism is to display the exhaust from your aircraft. It's also a fun way to find your flying companion in dual-player flight.

To turn the smoke system on or off

You can also turn exhaust smoke on or off in Flight Simulator by pressing the I key.

- From the Sim menu, choose Smoke System.

  A check mark beside the command name indicates that the smoke system is turned on. Choose the command again to turn it off.

Flying or Saving Situations

Flight Simulator offers a choice of ready-made situations to test your flying skills. You can practice landing at a busy airport, buzz an aircraft carrier, fly at night, weather a thunderstorm, or have fun chasing a hot-air balloon. If you want to be more creative, you can design your own situation and fly it whenever you want.

To fly a situation

1. From the Options menu, choose Situations.

   Flight Simulator displays the Situations dialog box.
2. From the list, choose the situation you want to fly.
3. Choose the OK button.

   Flight Simulator starts the situation of your choice.

To reset a situation

- From the Options menu, choose Reset Situation.

  Flight Simulator immediately resets the situation at the beginning.

To save a situation

1. First, set up your situation just the way you want it. Choose an aircraft, airport, weather conditions, time of day, and set the radio frequencies the way you want them.
2. From the Options menu, choose Save Situation.

   Flight Simulator displays the Save Situation dialog box.
3. Type a title and a description for your situation. Press ENTER after you type each.

   For example, in the Situation Title box, type **David's Lesson** and then press ENTER. In the Description box, type **Takeoff from Paine Field to the northwest**

and pull the power. Check student's knowledge of emergency procedures. Press ENTER when you have finished typing the description.

4 Type a filename for your situation (up to eight characters), and press ENTER.

If you don't give your situation a filename, Flight Simulator creates one for you.

5 Choose the Options button to change the options you save with your situation.

Flight Simulator displays the Save Situation Options dialog box.

Any changes you make in the Situation Options dialog box affect only this situation. You can make changes that affect all your situations by choosing Preferences from the Options menu, and then choosing the Situation Options button. For more information, see "Situation Options" on page 10.

6 Choose the options you want for your situation.

- Choose the Instrument Panel And View Windows Positions check box to save the instrument panels and view windows just as you want them. For example, if you display multiple panels and want them always to appear with the situation, check this box.
- Choose the Aircraft check box to save the specific aircraft you are using with this situation.
- Choose the Dynamic Scenery check box to save the specific dynamic scenery you are using with this situation.
- Choose the Weather check box to save the specific weather conditions you are using with this situation.

7 Choose the OK button to return to the Save Situation dialog box, and then choose the OK button again to return to Flight Simulator.

To change information about a situation

1 From the Options menu, choose Situations.

Flight Simulator displays the Situations dialog box.

2 From the list, choose the situation you want to change.

3 Choose the Change Information button.

Flight Simulator displays the Change Situation Information dialog box.

4 Type a new title, filename, or a new description for your situation.

5 Choose the OK button.

Flight Simulator returns you to the Situations dialog box.

6 Choose the OK button again to return to Flight Simulator.

To delete a situation

1. From the Options menu, choose Situations.

   Flight Simulator displays the Situations dialog box.

2. From the list, choose the situation you want to delete.
3. Choose the Delete Situation button.

   Flight Simulator displays the message: "Are you sure you want to delete the selected situation?"

4. Choose the OK button to delete the situation.
   –or–
   Choose the Cancel button.
5. Choose the OK button again to return to Flight Simulator.

Playing and Recording Videos

You can choose Flight Simulator's prerecorded videos and watch flying feats performed before your very eyes, or you can create your own videos to show friends your prowess in the air.

To play a video

1. From the Options menu, choose Video Recorder.

   Flight Simulator displays the Video Recorder dialog box.

2. From the list, choose the video you want to play.
3. Choose the Play Selected Video button.

   Flight Simulator displays the Play Selected Video dialog box.

4. Choose the OK button.

   Flight Simulator starts the video.

5. Press the ESC key to stop the video.

To record a video

1. From the Options menu, choose Video Recorder.

   Flight Simulator displays the Video Recorder dialog box.

2. Choose the Record New Video button.

   Flight Simulator displays the Record New Video dialog box.

3. Choose the recording interval you want.

   You can choose a 1-second or 5-second interval rate. When you choose the 1-second interval rate you get a smoother and more accurate video because you are recording second by second; when you choose the 5-second interval you can record longer, but the video may not be as accurate.

4. Choose the OK button.

   Flight Simulator starts recording and displays the interval status in the lower-left corner of the screen.

5. Press the BACKSLASH (\) key to stop recording.

   Flight Simulator displays the Stop Video Recording dialog box.

6. In the Video Title box, type a title for your video, and then choose the button you want.

   - Choose the Save Video button to save the video with the title displayed in the Video Title box.
   - Choose the Cancel button to resume video recording.
   - Choose the Review Video button to review your video.
   - Choose the Discard Video button to return to Flight Simulator without saving the video.

To change information about a video

1. From the Options menu, choose Video Recorder.

   Flight Simulator displays the Video Recorder dialog box.

2. From the list, choose the video you want to change.

3. Choose the Change Information button.

   Flight Simulator displays the Change Video Information dialog box.

4 Type a new name or a new description for your video.

5 Choose the OK button.

Flight Simulator returns you to the Video Recorder dialog box.

6 Choose the OK button again to return to Flight Simulator.

To delete a video

1 From the Options menu, choose Video Recorder.

Flight Simulator displays the Video Recorder dialog box.

2 From the list, choose the video you want to delete.

3 Choose the Delete Selected Video button.

Flight Simulator displays the message: "Are you sure you want to delete the selected video?"

4 Choose the OK button to delete the video.
–or–
Choose the Cancel button.

5 Choose the OK button again to return to Flight Simulator.

Photographing Your Flight

You can take photographs while you fly to immortalize your greatest moments in the air. Capture the instruments in front of you and the scenery below. Then print your pictures and display them for all the world to see.

To photograph your flight

1 From the Views menu, choose Flight Photograph.

Flight Simulator displays the Flight Photograph dialog box.

2 Under Window, choose the area you want to photograph.

You can photograph the whole screen, View 1, View 2, Map View, or the instrument panel.

3 Type a filename for your photograph.

For example, type **city**

4 Choose the OK button.

Flight Simulator saves the photograph in your FLTSIM5 directory as a .PCX file. You can view the photograph using Microsoft Windows Paintbrush™ or another graphics program. For more information, see the Paintbrush chapter in the *Microsoft Windows User's Guide* or the documentation for the graphics program that you are using.

Pausing Flight Simulator

You can stop Flight Simulator whenever you want to. When you are flying a complicated maneuver and aren't sure about the next step, pause the simulation and look up the information you need. When you are on final approach for a night landing at Chicago-O'Hare and your oven timer announces that the pizza is ready, pause Flight Simulator and postpone touchdown until after dinner.

To pause Flight Simulator

You can also pause Flight Simulator by pressing the P key.

▶ From the Sim menu, choose Pause.

A check mark beside the command name indicates that Pause is turned on and simulation has stopped. Choose the command again to continue your flight.

Displaying Simulator Information

It's easy to display information about your current aircraft, situation, or the scenery around you, as well as system information.

To display information about Flight Simulator

1 From the Options menu, choose Simulator Info.

Flight Simulator displays the Simulator Info dialog box.

2 Check information about your situation, aircraft, scenery, or the version of Flight Simulator you are using, as well as information on expanded and extended memory, and available disk space.

3 Choose the OK button to return to Flight Simulator.

Chapter 22 Flying Adventures

Now that you know Flight Simulator like the back of your hand and are on the cutting edge of the air above you, here are some flying adventures to test your aerial acumen. The following scenarios demand knowledge of the instruments, understanding of the elements, and a firm hand on the controls. They also give you a chance to record your flights for posterity using such features as the course tracker, the video recorder, and the logbook.

New York City Ballet

Practice your precision skills by flying the Cessna through a figure eight. Take off from LaGuardia Airport, bank right around the proud Statue of Liberty, head between the twin towers of the Big Apple's World Trade Center, bank left around the Empire State Building, and then loop back to the Statue of Liberty.

To fly a figure eight in downtown Manhattan

1 From the Options menu, choose Aircraft. Make sure Map View is active by pressing the NUMLOCK key, and then press the PLUS SIGN or MINUS SIGN key to zoom in or out.

2 From the list, choose the Cessna Skylane RG, and then choose the OK button.

3 From the World menu, choose Airports.

   Flight Simulator displays the Airports dialog box.

4 From the list, choose New York, choose LaGuardia Airport—Runway 22, and then choose the OK button.

   Flight Simulator positions your Cessna on runway 22 at Long Island's LaGuardia Field.

5 From the Options menu, choose Flight Analysis.

   Flight Simulator displays the Flight Analysis dialog box.

6 Choose Course Tracking, and then choose the Display Course check box.

   - Under Track Length, choose the Long option.
   - Under Resolution, choose the Medium option, and then choose the OK button.

7 Take off to the southwest, climb to 1000 feet, and fly parallel to Manhattan Island along the East River until you reach the southwest tip of Brooklyn.

If you turn on Map View and it is not displayed, press the APOSTROPHE key to bring the map window to the front.

8 From the Views menu, choose Map View so that you can understand the big picture as you fly.

9 At the southwest tip of Brooklyn (the rounded land mass sticking out into the water), make a 30-degree bank turn to the right and look for Liberty Island and the Statue of Liberty.

It first appears as a small blue dot on the left side of the harbor near the shoreline.

10 Descend to 500 feet for a better view while you fly between the Statue of Liberty and the New Jersey shore.

11 Bank right around the statuesque lady, and head for the twin towers of the World Trade Center.

12 Climb to 1000 feet and pass between the towering columns of glass and steel.

13 Head straight toward the Empire State Building in front of you, and bank right to pivot around it.

Check out the Brooklyn Bridge in the background.

14 Complete your figure eight by flying through the shining towers of the World Trade Center once more.

15 Descend to 500 feet and, this time, bank left around Lady Liberty.

Congratulations—you made it! Wipe your brow and keep flying. There are lots more sights to see in New York City.

Mountain Mission

Before taking off, review a map of the United States and keep it handy while you fly.

Find the highest peak in the Cascade range. Take off from Logan Field in Boston and fly to Seattle. When you find Mount Rainier, take a 360-degree video of its snowy wonders as evidence.

To fly to Seattle and find Mount Rainier

1 From the Options menu, choose Aircraft.

Flight Simulator displays the Aircraft dialog box.

2 From the list, choose the Learjet 35A, and then choose the OK button.

3 From the World menu, choose Airports.

Flight Simulator displays the Airports dialog box.

4 From the list, choose New York (the New York scenery area, like the New York sectional, includes New York, Massachusetts, Maine, Rhode Island, and Connecticut), choose Logan Int'l Airport—Runway 4L, and then choose the OK button.

Flight Simulator positions your Learjet on runway 4L at Boston's Logan Field.

If you turn on Map View and it is not displayed, press the APOSTROPHE key to bring the map window to the front.

5 From the Views menu, choose Map View so that you can understand the big picture as you fly.

Make sure Map View is active by pressing the NUMLOCK key, and then press the PLUS SIGN or MINUS SIGN key to zoom in or out.

6 Take off to the northeast and hang a left to a heading of 330 degrees.

7 Fly until you have the Saint Lawrence Seaway in sight and bank left again to a heading of about 245 degrees.

Make View 1 the active window, and then press the S key to cycle to Spot view. Press SHIFT+KEYPAD 5 to look straight down and keep the fuselage of your aircraft lined up with the Seaway.

8 Follow the Seaway until you reach Lake Ontario, and then head due west (270 degrees).

9 Refer to your map of the United States and choose visual checkpoints (for example, the Mississippi River, the Missouri River, and so on) to help you keep your bearings on the way to the Pacific Northwest.

10 Once you are on the West Coast, fly north or south (depending on where you end up) toward 14,410-foot (4391 meters), snow-capped Mount Rainier. You can't miss it.

Press SHIFT+KEYPAD 4 or SHIFT+KEYPAD 6 to record a side view of your aircraft with Mount Rainier looming majestically in the background.

11 From the Options menu, choose Video Recorder.

Flight Simulator displays the Video Recorder dialog box.

12 Choose the Record New Video button.

Flight Simulator displays the Record New Video dialog box.

13 Choose a recording interval, and then choose the OK button to start recording your video.

14 Press the BACKSLASH key (\) to stop recording.

Flight Simulator displays the Stop Video Recording dialog box.

Just a warning: the first UFO ever sighted was by a pilot flying in the vicinity of Mount Rainier.

15 Type a name and filename for your video, and then choose the Review Video button to watch your fancy camera work, or the Save Video button to save it and return to Flight Simulator.

Great job! Not only are you a Learjet whiz but a filmmaker as well.

San Francisco Tour in the Sopwith

Take off from San Francisco in a Sopwith and see the sights. Fly under the Golden Gate Bridge, over forbidding Alcatraz Island, and across the beautiful bay to land in Oakland. Fasten your seat belt—it's going to be a bumpy ride!

To fly over San Francisco in the Sopwith

1 From the Options menu, choose Aircraft.

Flight Simulator displays the Aircraft dialog box.

2 From the list, choose the Sopwith Camel, and then choose the OK button.

3 From the World menu, choose Airports.

Flight Simulator displays the Airports dialog box.

4 From the list, choose San Francisco, choose San Francisco Int'l—Runway 28R, and then choose the OK button.

Flight Simulator positions your Sopwith Camel on runway 28R at the San Francisco International Airport.

If you turn on Map View and it is not displayed, press the APOSTROPHE key to bring the map window to the front.

5 From the Views menu, choose Map View so that you can understand the big picture as you fly.

Make sure Map View is active by pressing the NUMLOCK key, and then press the PLUS SIGN or MINUS SIGN key to zoom in or out.

6 Take off heading west until you reach the coast, and bank right along the coastline at a heading of 345 degrees.

If you look out to the northwest, you can see the huge aircraft carrier USS Nimitz making its way toward the Golden Gate Bridge.

7 Descend to get a better look at the Nimitz and to get ready to fly under (yes, under) the Golden Gate Bridge.

8. Bank right into San Francisco Bay and head toward the bridge.
9. Fly under (okay, you can fly over it if you want) the Golden Gate Bridge and head for Alcatraz Island.
10. When you're over Alcatraz, turn southward toward the Bay Bridge.
11. Once you reach the Bay Bridge, you'll see the runways of the Alameda Naval Air Station on the land mass to your left.
12. Just beyond and to your left is the Metropolitan Oakland International Airport, so line your Sopwith up for a landing on runway 27R.

    Bravo! You made it, you daredevil!

To Paris with Lindbergh

When Charles Lindbergh flew the first nonstop transatlantic flight, he did it on a wager. In 1919, a Franco-American philanthropist, Raymond Orteig, offered $25,000 in prize money to the first person to fly solo from New York to Paris. By 1927, several pilots had been killed or injured in failed attempts, and the unclaimed prize money finally lured the "Lone Eagle" and his single-engine monoplane, "The Spirit of St. Louis," to give it a try. There's no money in it for you, but this is a great way to exercise your sense of adventure and your flying skills. Do it, as Lindbergh did, with guts and glory!

To fly the Lindbergh route from New York to Paris

Before taking off, review maps of the eastern United States, the world, and northwestern France, and keep them handy while you fly.

1. From the Options menu, choose Aircraft.

   Flight Simulator displays the Aircraft dialog box.
2. From the list, choose the Cessna Skylane RG, and then choose the OK button.
3. From the World menu, choose Airports.

   Flight Simulator displays the Airports dialog box.

Lindbergh took off from Roosevelt Field on Long Island, near New York City, but your trip will start at JFK.

4. From the list, choose New York, choose Kennedy Int'l—Runway 31L, and then choose the OK button.

   Flight Simulator positions your aircraft on runway 31L at Long Island's John F. Kennedy International Airport.
5. From the World menu, choose Set Time And Season.

   Flight Simulator displays the Set Time And Season dialog box.

With Flight Simulator, you can, of course, cheat a little and cut those 33.5 grueling hours to a fraction of the time. Choose Simulation Speed from the Sim menu and change the rate of simulation to whatever you want.

6 Under Set Season, choose Spring (Lindbergh began his flight on May 20, 1927).

7 Choose Set Exact Time, and set the clock to the hour when Lindbergh left.

- In the Hours box, type **7**
- In the Minutes box, type **52**

8 Choose the OK button, and then watch the sky change color as the sun and moon rise and set.

9 From the Options menu, choose Logbook.

Flight Simulator displays the Standard Pilot Logbook dialog box.

10 Choose the Create Logbook button.

Flight Simulator displays the Create Logbook dialog box.

11 Type a title and filename for your logbook, and then choose the OK button.

Flight Simulator displays the Standard Pilot Logbook dialog box and adds your new logbook to the list.

12 Choose your new logbook from the list, choose the Log Flight Time check box, and then choose the OK button

Flight Simulator begins logging your transatlantic flight.

If you turn on Map View and it is not displayed, press the APOSTROPHE key to bring the map window to the front.

13 From the Views menu, choose Map View so that you can understand the big picture as you fly.

Make sure Map View is active by pressing the NUMLOCK key, and then press the PLUS SIGN or MINUS SIGN key to zoom in or out.

14 Take off to the northeast over Long Island Sound, and head toward Cape Cod.

15 Continue in a northeasterly direction until you get to St. John's on the southern tip of Nova Scotia, and then head due east over the Atlantic Ocean.

16 Climb to 10,000 feet to keep clear of any clouds, and then descend when it's clear.

Lindbergh sometimes flew as close as 10 feet above the water to take advantage of the aerodynamic effects of flying close to the ground (or in this case, close to the water), which make flying less of an effort.

After hours of looking at nothing but ocean, watch out for mirages. You might start seeing imaginary islands, as Lindbergh did.

17 As the evening approaches, make sure you know what compass heading to steer for, and take a coffee break to keep alert through the long night.

18 At the end of the second day, look for Cape Valentia and Dingle Bay on the southwestern tip of Ireland.

19 Fly southeast from there and, a couple of hours later, you'll see Plymouth on the southern coast of England.

20 Cross the English Channel and look for Le Havre.

21 Next, you'll see the lights of Paris, and if you can find the Eiffel Tower, circle it as Lindbergh did at an altitude of 4000 feet.

22 And finally, turn your little Cessna to the northwest and prepare to land at Le Bourget.

If you were Lindbergh, your instrument-panel clock would read 5:21 P.M., New York time. In Paris, that's 10:21 P.M. and the night life is just starting.

It's up to you—break out the champagne and celebrate this momentous event, or turn out the light and catch up on the sleep you missed. Don't forget to review your logbook and add anecdotes. Great job!

Winter Excursion Over the Alps

If you want to try flying at higher altitudes and plan a skiing trip for Christmas, take this scenic excursion. Take off from the Munich Airport, nestled in the Bavarian Alps, and fly to Innsbruck, Austria. Amaze yourself with the wonders of nature, but watch out for snow on the runway!

Before taking off, review maps of Germany and Austria and keep them handy while you fly.

To fly from Munich to Innsbruck

1 From the Options menu, choose Aircraft.

Flight Simulator displays the Aircraft dialog box.

2 From the list, choose Cessna Skylane RG, and then choose the OK button.

3 From the World menu, choose Airports.

Flight Simulator displays the Airports dialog box.

4 From the list, choose Munich, choose Munich Airport—Runway 26R, and then choose the OK button.

Flight Simulator positions your aircraft on runway 26R at the Munich Airport.

If you turn on Map View and it is not displayed, press the APOSTROPHE key to bring the map window to the front.

5. From the World menu, choose Set Time And Season.

   Flight Simulator displays the Set Time And Season dialog box.

6. Under Set Season, choose Winter.

   Make sure you're wearing heavy flight gear and gloves. You'll need them!

7. Under Set Time Of Day, choose Day so that you can see the scenery clearly.

8. From the Views menu, choose Map View so that you can understand the big picture as you fly.

   Make sure Map View is active by pressing the NUMLOCK key, and then press the PLUS SIGN or MINUS SIGN key to zoom in or out.

9. Take off to the south and fly between Starnberger See (a big lake to your right) and Tegernsee (a little lake to your left).

10. Climb to a cruising altitude of 12,500 feet.

    At 12,500 feet, you are high enough to avoid treacherous wind currents from the mountains, but low enough to see some of their splendor.

11. Continue on a southward heading.

    About halfway between Munich and Innsbruck is Oberammergau, the site of the famous passion play, and then there's Garmisch-Partenkirchen, the ideal ski resort.

12. Continue south over the Bavarian Alps.

    You'll fly over the Zugspitze, the highest peak in Germany, at 9718 feet or 2962 meters, and the Wetterstein and Karwendel mountain ranges.

13. Start descending just north of the Inntal Valley and look for the Innsbruck airport.

    The altitude of the airport is 1906 feet. That's a long way down and you don't want to hurt your ears, so take it easy.

14. Overfly the airport to get your bearings and prepare for your landing approach.

When you are safely on the ground, congratulate yourself. A winter crossing of the Alps is something to write home about!

Chapter 23 More Information on Flying

To order the Microsoft Press companion book for Flight Simulator version 5.0, in the USA, call 1-800-MSPRESS.

Flying Flight Simulator can be addictive. If it whets your appetite for anything and everything related to flying, take a look at the following bibliography. We've listed a wide variety of books and other materials to further your flight training. Chances are you can find these publications at your local library but, if you want to start your own library, you can purchase them from fixed-base operators (FBOs), flight-training schools, or aviation stores.

For more specific information on Microsoft Flight Simulator 5.0, read Timothy Trimble's companion book, *Flight Simulator Adventure Guide,* from Microsoft Press, 1993.

Flight Training Books

It is wise to supplement your flight lessons with reading. The more you read, the more you reinforce your knowledge of aircraft functions, performance characteristics, instruments, controls, principles of flight, environmental variables, and emergency procedures. Reading about flying makes you a better pilot.

You can order many of these publications directly from The Aviator Store, 7201 Perimeter Road South, Seattle, WA 98108 USA. In the USA, call 1-800-635-2007.

- ***Aviation Fundamentals,*** Jeppesen Sanderson, Inc., Englewood, CO, © 1988, 1989, 1991, 1992.
- ***Flight Training Handbook,*** AC61-21A, U.S. Department of Transportation, Federal Aviation Administration, Washington, DC, 1980.
- ***Instrument Flying Handbook,*** AC61-27C, U.S. Department of Transportation, Federal Aviation Administration, Washington, DC, 1980.
- ***Pilot's Handbook of Aeronautical Knowledge,*** AC 61-23B, U.S. Department of Transportation, Federal Aviation Administration, Washington, DC, 1980.
- ***Private Pilot Manual,*** Jeppesen Sanderson, Inc., Englewood, CO, 1991.
- ***Proficient Pilot,*** Barry Schiff, Macmillan Publishing, Inc., NY, 1985.
- ***Proficient Pilot II,*** Barry Schiff, Macmillan Publishing, Inc., NY, 1987.
- ***Stick and Rudder, An Explanation of the Art of Flying,*** Wolfgang Langewiesche, McGraw-Hill, Inc., NY, 1972, © 1944.
- ***Weather for the New Pilot,*** Tom Morrison, Iowa State University Press, Ames, IA, 1991.

If you are a glider enthusiast, here are a few books that will teach you more about sailplanes and soaring.

- ***Schweizer Soaring School Manual,*** Schweizer Aircraft Corp., Elmira, NY, 1982.
- ***Soaring Flight Manual,*** Soaring Society of America, Hobbs, NM, 1992.
- ***The Joy of Soaring, A Training Manual,*** Carke Conway, Soaring Society of America, Hobbs, NM, 1989.

Reference Books for Pilots of All Levels

The following books will help you perfect your skills and add to your knowledge base on flying.

- ***Airman's Information Manual (AIM),*** U.S. Superintendent of Documents, U.S. Government Printing Office, Washington, DC, published annually.
- ***Anatomy of a Spin,*** John Lowery, Airguide Publications, Inc., Long Beach, CA, 1981.
- ***Crop Dusters,*** Photography by Henry Rasmussen, Motor Books International, Osceola, WI, 1986.
- ***Cross Country Flying, Third Edition,*** R. Randall Padfield, Tab Books, Blue Ridge Summit, PA, 1991.
- ***Federal Aviation Regulations (FAR),*** U.S. Superintendent of Documents, U.S. Government Printing Office, Washington, DC, published annually.

If you are flying in international airspace, make sure you check the International Flight Information Manual for VFR minimums and general regulations.

- ***International Flight Information Manual,*** U.S. Department of Transportation, Federal Aviation Administration, Air Traffic Rules and Procedures Service, Washington, DC, published annually.
- ***Making Perfect Landings in Light Airplanes,*** Ron Fowler, Iowa State University Press, Ames, IA, 1984.
- ***Making Perfect Takeoffs in Light Airplanes,*** Ron Fowler, Iowa State University Press, Ames, IA, 1991.
- ***Stalls, Spins, and Safety,*** Sammy Mason, Macmillan Publishing, Inc., NY, 1982.
- ***The Art of Instrument Flying,*** J.R. Williams, Tab Books, Blue Ridge Summit, PA, 1991.
- ***The Instrument Flight Manual, The Instrument Rating,*** William K. Kershner, Iowa State University Press, Ames, IA, 1990.

- ***The Pilot's Radio Communication Handbook,*** Paul E. Illman and Jay Pouzar, Tab Books, Blue Ridge Summit, PA, 1988.
- ***The Right Seat, An Introduction to Flying for Pilots' Companions and Would-be Pilots,*** Avram Goldstein, CFI, CFII, Stanford, California, 1986.
- ***Understanding Flying,*** Richard L. Taylor, Thomasson-Grant, Inc., Charlottesville, VA, 1992, © 1977.
- ***Where Am I, ADF & Omni (VOR) Instruction Manual,*** Ken Stremming, Haldon Books, Palatine, IL, 1984.

For more information on the French and German sectionals, contact the International Civil Aviation Organization (ICAO) in your area.

Updated sectional maps for all regions of the United States are published every six months by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, or by Jeppesen Sanderson, Inc. These include terrain variations, cities, towns, rivers, highways, railroads, and other distinctive landmarks that you can use as visual checkpoints. They also include airports, navigation and communication facilities, airspace, and obstructions.

The following sectionals cover all the main geographic areas detailed in Flight Simulator.

- ***Chicago Sectional Aeronautical Chart***
- ***Los Angeles Sectional Aeronautical Chart***
- ***Munich Sectional Aeronautical Chart***
- ***New York Sectional Aeronautical Chart***
- ***Paris Sectional Aeronautical Chart***
- ***San Francisco Sectional Aeronautical Chart***
- ***Seattle Sectional Aeronautical Chart***

Books on Aerodynamics

If you want to advance your knowledge of aerodynamics, we suggest that you study the following books.

- ***Aerodynamics for Pilots,*** Bradley Jones, U.S. Government Printing Office, Washington, DC, 1940.
- ***The Advanced Pilot's Flight Manual***, William Kershner, Iowa State University Press, Ames, IA, 1992, © 1967, 1970, 1976, 1985.

- ***The Fullness of Wings: The Making of a New Daedalus,*** Gary Dorsey, Viking Books, NY, 1990.
- ***The Illustrated Guide to Aerodynamics,*** Hubert Smith, Tab Books, Blue Ridge Summit, PA, 1992.

Specific Aircraft References

You can order many of these publications directly from Sporty's Pilot Shop, Clermont County Airport, Batavia, Ohio, 45103 USA. In the USA, call 1-800-543-8633.

A comprehensive book on aircraft is always a good addition to your library. Pilot operating handbooks or manuals on specific types of aircraft are also available in most aviator stores. These are good books to keep as references so you can look up performance characteristics that can affect your flight.

- ***Cessna 150 & 152,*** Bill Clarke, Tab Books, Blue Ridge Summit, PA, 1987.
- ***Cessna 172,*** Bill Clarke, Tab Books, Blue Ridge Summit, PA, 1987.
- ***Jane's All the World Aircraft,*** Jane's Information Group Limited, Sentinel House, Surrey, U.K., published annually.
- ***Learjets,*** Donald J. Porter, Tab Books, Blue Ridge Summit, PA, 1990.

Adventure Novels on Flying

If you want an easier approach to learning, read some of the great novels on flying. Now that you are an experienced pilot, you'll identify more readily with stories of exhilaration and danger in the air.

- ***Airman's Odyssey,*** Antoine de Saint-Exupery, Reynal, NY, 1942.
- ***Fate is the Hunter,*** Ernest Gann, Simon and Schuster, NY, 1986, © 1961.
- ***Night Flight,*** Antoine de Saint-Exupery, The Century Company, NY, 1932.

Biographies of Great Aviators

Maybe a book about your flying adventures will one day be among these.

- ***Amelia Earhart, Aviation Pioneer,*** Roxane Chadwick, Lerner Publications, Minneapolis, MN, 1987.
- ***Gatchina Days, Reminiscences of a Russian Pilot,*** Alexander Riaboff (Von Hardesty, Editor), Smithsonian Institution Press, Washington, DC, 1986.
- ***Howard Hughes and His Flying Boat,*** Charles Barton, Tab Books, Blue Ridge Summit, PA, 1982.

- ***Pioneers of Flight,*** Brian Williams, Steck-Vaughn Publishers, Austin, TX, 1990.
- ***Straight on till Morning, The Biography of Beryl Markham,*** Mary S. Lovell, St. Martin's Press, NY, 1987.
- ***The Sky is My Kingdom—Hanna Reitsch, Memoirs of the Famous German WWII Test-Pilot,*** Greenhill Books, London, 1991, © 1955.
- ***The Sound of Wings: The Life of Amelia Earhart,*** Mary S. Lovell, St. Martin's Press, NY, 1989.
- ***The Wright Brothers: How They Invented the Airplane,*** Russell Freedman, Holiday House, NY, 1991.
- ***Wilbur and Orville, A Biography of the Wright Brothers,*** Fred Howard, Alfred A. Knopf, NY, 1987.
- ***Women of the Air,*** Judy Lomax, Dodd, Mead & Co., NY, 1987.

Flight Video Series

Another way to learn and reinforce your knowledge is by watching videos. There are several courses that take you through ground school step by step. It can be highly instructive to see how a storm develops or to watch an instructor make a crosswind landing.

- ***King Video Private Pilot Course***
- ***Jeppesen Sanderson FlighTime Video Series***
- ***Pure Flight—Transition to Soaring***

Online Information Services

To share information and tips with other Flight Simulator pilots, you can contact organizations such as MicroWINGS, the international association for aerospace simulation, 381 Casa Linda Plaza, #154, Dallas, TX 75218 USA. In the USA, call (214) 324-1406.

You can use online information services to talk to computer pilots and real pilots around the world. Through electronic mail, you can share tips, tricks, and flight techniques. You can also discover how others get the best performance from Flight Simulator, and get answers to your more technical questions.

There are several online information services available. These services offer general aviation and Flight Simulator-specific forums that engender discussions on flight-related topics, or helpful product-specific information. You can find out about online information services from your local software vendor.

Chapter 24 Common Questions and Answers

This chapter provides answers to the most commonly asked questions and offers quick tips for using Microsoft Flight Simulator more efficiently. Before you call for information or technical assistance, please read the following section.

Setup

For more information on how to create a program group and item, see your Microsoft Windows documentation.

Q: Can I run Flight Simulator from Microsoft Windows?

A: You can run Flight Simulator from the Microsoft Windows operating system, but it will run as a full-screen application, rather than in its own window.

To run Flight Simulator from Microsoft Windows

1. Install Flight Simulator following the steps provided on page 3.
2. Start Microsoft Windows.
3. From the Window menu in Program Manager, choose the group to which you want to add the Flight Simulator icon.
4. From the File menu in Program Manager, choose New.

   Program Manager displays the New Program Object dialog box.
5. Under New, choose Program Item, and then choose the OK button.

   Program Manager displays the Program Item Properties dialog box.
6. Type the following information:

   In the Description box, type **Flight Sim 5.0**

   In the Command Line box, type **fs5.pif**

   In the Working Directory box, type the drive and directory where Flight Simulator is located. For example: **c:\fltsim5**
7. Choose the OK button.

   Program Manager creates a Flight Simulator icon.

8 Double-click the Flight Simulator icon to run Flight Simulator.

If you don't see the Flight Simulator icon, click the up or down arrow on the scroll bar or press the arrow keys to scroll up or down until you locate it.

Flight Simulator performs best when it is the only program running. For this reason, we recommend that you run Flight Simulator from MS-DOS instead of from Microsoft Windows.

For tips on troubleshooting during Setup, see the "Troubleshooting Guide for Setup" on the inside of the back cover.

Q: How much disk space do I need to install Flight Simulator?

A: Flight Simulator requires 14 MB disk space and must be installed on a hard drive.

Q: How do I modify Setup after Flight Simulator is already installed?

A: There are two ways to change your Flight Simulator Setup after installation.

On some computers, Setup takes between 15 and 30 minutes. This is a great opportunity to look through the Microsoft Flight Simulator Pilot's Handbook and get a jump start on flying skills.

To modify your original Flight Simulator Setup

▶ From the Options menu, choose Preferences, and then make the changes you want by choosing the appropriate buttons (for example, choose the Display button to change your video mode).
–or–
From the Options menu, choose Exit. At the MS-DOS prompt, type **setup**. Change your original configuration as you run the Setup program.

Memory

Q: What do I need to know about memory and Flight Simulator?

A: Flight Simulator can use three types of memory: conventional, expanded, and extended memory.

Conventional memory is memory in the range of zero to 1 MB. The first IBM-compatible PCs (8088/8086) could only address up to 1 MB of memory at a time. Only 640K of this space actually contains physical memory (RAM). The other 384K is reserved for computer hardware such as video cards and the ROM BIOS (which controls the basic functions of a computer).

Expanded Memory (EMS) is a type of physical memory—up to 8 MB—on IBM PCs and compatible microprocessors. Expanded memory requires an interface called the Expanded Memory Manager (EMM), which maps pages (blocks) of bytes from expanded memory onto reserved areas called "page frames" in the conventional memory area.

Extended Memory (XMS) is system memory beyond 1 MB on 80286 and higher microprocessors. Extended memory is not typically available to MS-DOS programs. However, Flight Simulator temporarily places the processor into protected mode and copies a portion of extended memory to conventional memory.

Q: Why do I need extended or expanded memory for Flight Simulator version 5.0?

A: Flight Simulator requires 1 MB or more of expanded or extended memory to store photo-realistic images such as textured sky, map view, scenery, and the instrument panel. If you have a sound card, Flight Simulator uses up to 256K extended memory to store sound effects.

For best performance and use of all Flight Simulator features, we recommend 2 MB or more of memory configured as expanded. If you have photo-realistic scenery disks, we recommend 2.5 MB or more of memory.

Q: How much memory do I need for Flight Simulator?

A: Flight Simulator is designed to run in as many memory configurations as possible. The minimum memory configuration is 530K free conventional memory and 256K free extended memory. You will not see photo-realistic scenery with this configuration.

To use all Flight Simulator features you will need 530K free conventional memory and 2 MB or more free memory configured as either expanded or extended with an appropriate memory driver.

Flight Simulator runs at the highest display rate with 2 MB of memory configured as expanded memory (EMS). If you want digitized sound effects for your sound board, you also need at least 256K of extended memory (XMS).

Q: How do I determine how much free memory my computer has?

A: If you have an earlier version of MS-DOS than 4.0, type **chkdsk** at the MS-DOS prompt. The number listed next to "bytes free" on the bottom line is the amount of free conventional memory.

If you have MS-DOS 4.0 or later, type **mem** at the MS-DOS prompt for a list of conventional, XMS, and EMS memory.

The memory configuration issue is complicated. Even PC experts have trouble with it. To ensure that your computer has the EMS and XMS memory you need, run Flight Simulator with MS-DOS version 6.0. The new memory manager and MEMMAKER auto-configuration utility in MS-DOS 6.0 will set up your computer's memory configuration for optimal performance.

Q: How do I configure my computer's memory as expanded?

A: MS-DOS versions 4.0 and later come with a program called EMM386 which makes expanded memory available on 80386 and higher computers. To learn more about EMM386, consult the *Microsoft MS-DOS User's Guide*. If you use other EMM programs, consult their documentation for configuration instructions.

Performance

Q: What type of computer is recommended to run Flight Simulator?

A: Flight Simulator will run on 80386, 80486, and Pentium computers. The recommended configuration is an 80386 or higher computer running at 33 MHz with at least 4 MB of memory, with 2 MB configured as expanded memory.

For best performance, use a 80486 or higher computer running at 33 MHz with at least 4 MB of memory, with 2 MB configured as expanded memory. It is important to remember that the faster the computer, the better the video performance and response time will be.

Q: How can I improve video performance and response time?

A: Overall, the faster the computer, the better the video performance and response time will be. Other solutions are:

- Fly in an area with fewer scenery objects.
- From the Options menu, choose Preferences, turn off the Dynamic Scenery At Startup check box, and then restart Flight Simulator.
- From the Options menu, choose Preferences, and then choose the Display button. In the Display Preferences dialog box, turn off the Textured Sky check box.
- From the Options menu, choose Preferences, and then choose the Display button. In the Display Preferences dialog box, turn off the Gradient Horizon check box.
- From the Scenery menu, choose Scenery Complexity and then, under Image Complexity, choose the Very Sparse option.
- From the Scenery menu, choose Scenery Complexity, and then choose the Wire-Frame Polygons check box to show only scenery outlines or the Horizon Only (No Scenery) check box to turn off scenery.
- Use a lower-resolution video mode. From the Options menu, choose Preferences, and then choose the Display button. Choose the mode you want from the list. For example, if you have an 80386 computer, choose VGA 320x400 256 colors.

Flight Simulator runs at the highest display rate with 1 MB of memory configured as expanded memory (EMS). For more information on memory and display rate, see "Memory" on page 194.

Video

Q: What video modes are available and which one should I choose?

A: Flight Simulator 5.0 supports the following video modes:

- EGA 640x350 16 colors
- SVGA 640x400 256 colors
- VGA 320x400 256 colors

Earlier versions of Flight Simulator used the EGA 640x350 16-color video mode as the highest resolution available for EGA and VGA video cards.

If you have an EGA card with 256K, choose the EGA 640x350 resolution.

Most VGA cards work with the VGA 320x400 256-color video mode. If your card does not work with this mode, try an EGA 640x350 mode.

Many SVGA cards can use the 640x400 256-color video mode. Flight Simulator supports the following video cards in this mode:

- ATI VGA Wonder +/XL
- Video 7
- Tseng Labs ET-4000*
- Trident 8900*
- Paradise SVGA
- S3 86C11*
- Vesa 1.2 compatible**
- Cirrus Logic 542X*

* The Tseng Labs ET-4000, Trident 8900, Cirrus Logic 542X, and S3 86C11 are graphics chips found in many popular video cards. Consult your video-card documentation to determine if your card is based on one of these chip sets. Manufacturers have variations on current and new chip sets that may not be in the above list. Because of internal manufacturing standards, a video mode for one chip will often work well on another current or future chip. For example, the S3 86C11 mode works well on an S3 805 chip set.

** Most video cards can be Vesa 1.2 compatible but they require you to load a driver first. Some video cards are Vesa 1.2 compatible without a driver. If your Super VGA video card is not in the above list, consult your documentation or video-card maker to determine if it can be Vesa 1.2 compatible.

If you have incorrectly installed your sound card and sound-card software, Flight Simulator will not run properly and may freeze your system. Consult your sound-card documentation for installation instructions.

Sound

Q: Do I need a sound card to hear sound effects in Flight Simulator?

A: You can have sound effects in Flight Simulator whether you have a sound card or not.

You can achieve the best quality sound effects if you have a sound card that Flight Simulator supports.

Q: Which sound cards does Flight Simulator support?

A: Flight Simulator provides support for the following sound devices:

- Microsoft Windows Sound System
- Creative Labs Sound Blaster
- Creative Labs Sound Blaster Pro
- Media Vision Pro Audio Spectrum
- Media Vision Thunderboard
- ATI Stereo FX
- AdLib
- AdLib w/Covox

Since the AdLib sound card does not support digital sound effects, most sounds play through the PC Speaker.

Q: How do I adjust the volume?

A: You cannot adjust the volume for the PC Speaker. In addition, you cannot adjust the volume for some sound cards. If you need more information on volume control, consult the documentation for your sound card.

Once you consult the documentation for your sound card and determine that it's possible to adjust the volume, choose Preferences from the Options menu, and then choose the Sound button. Choose Volume and adjust the volume control by dragging the slider bar or by pressing the LEFT ARROW or RIGHT ARROW key. If the volume control is unavailable, it means you cannot adjust the volume in Flight Simulator.

Q: Why are the sound effects for Flight Simulator distorted or not working?

A: When you install Flight Simulator, Setup suggests factory defaults for your type of sound card. If you are sure that the default sound card is correct, you may need to change the Interrupt and/or the Base Address settings. Consult the documentation that came with your sound board to determine what the correct settings are. To change sound settings, choose Preferences from the Options menu, and then choose the Sound button.

Dual-Player

Q: I can see my flying companion's plane, but he or she can't see mine.

A: Make sure you disable special modem functions such as data compression and error correction.

In addition, make sure there are no interrupt conflicts between your modem and other hardware cards. If you are using COM1 or COM3, make sure no other hardware cards occupy Interrupt 4. If you are using COM2 or COM4, make sure no other hardware cards occupy Interrupt 3.

Q: What are the recommended pin connections for a null modem?

A: PCs can communicate using as few as three wires, but Flight Simulator requires many more. The pinouts differ depending on what type of serial port you have. The following chart lists which pins correspond to which communications signal.

COM signal	AT 9-pin port	PC 25-pin port
DCD	1	8
RX	2	3
TX	3	2
DTR	4	20
GND	5	7
DSR	6	6
RTS	7	4
CTS	8	5
RI	9	22

This null modem requires five wires going through the cable, and two jumpers on each connector side. Using the above chart, you can make a cable that goes from one connector to a different type (for example, 25-pin to 9-pin).

Q: What connections do I use to make a null modem for PC-to-PC communications that will work with Flight Simulator and any other communications program?

A: On the connector side, jumper the DCD and DSR pins together, and then jumper the RTS and CTS pins. Going through the cable, cross RX and TX lines, cross DTR and DSR lines, and then connect the GND line.

Appendixes

This section includes information on flying Flight Simulator using the mouse, keyboard, and joystick. It also includes sectional aeronautical charts, directories, and runway maps, and performance specifications for Flight Simulator's aircraft.

Appendix A, "Using the Mouse, Keyboard, and Joystick," includes information about use, calibration, and sensitivity controls for the mouse, keyboard, and joystick, plus instructions for setting up one or two joysticks.

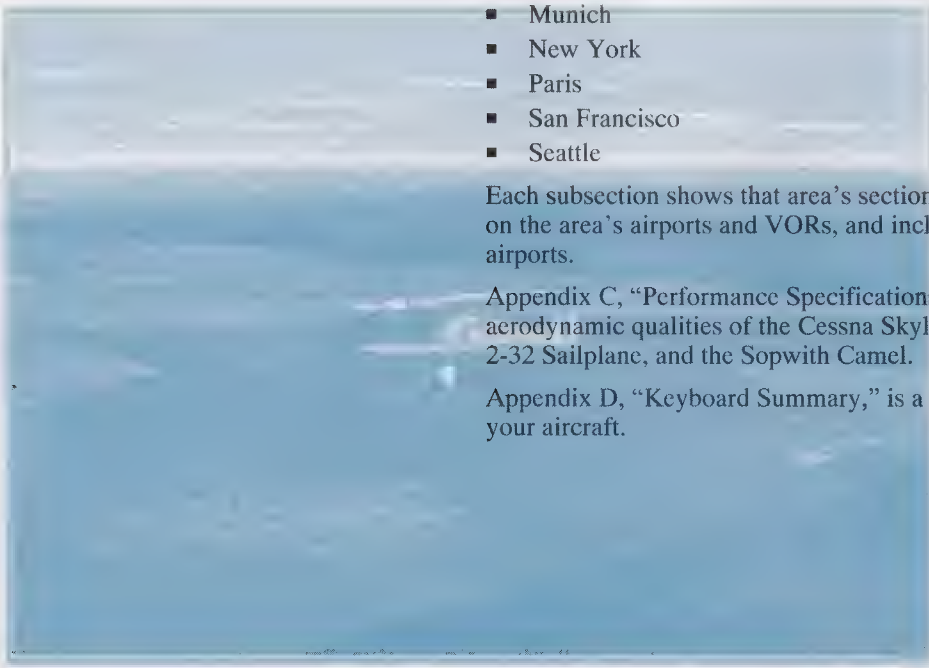
Appendix B, "Sectionals, Directories, and Runway Maps," is divided into subsections for each of the seven main geographic areas detailed in Flight Simulator:

- Chicago
- Los Angeles
- Munich
- New York
- Paris
- San Francisco
- Seattle

Each subsection shows that area's sectional map, lists and provides information on the area's airports and VORs, and includes runway maps for some of the larger airports.

Appendix C, "Performance Specifications," gives you technical information on the aerodynamic qualities of the Cessna Skylane RG, the Learjet 35A, the Schweizer 2-32 Sailplane, and the Sopwith Camel.

Appendix D, "Keyboard Summary," is a list of all the keyboard controls for your aircraft.



Appendix A Using the Mouse, Keyboard, and Joystick

You use the mouse, keyboard, and one or two joysticks for flight-control functions. Along with the Flight Simulator instrument panel, this is all the equipment you need to fly your aircraft. You can adjust the sensitivity of the mouse, keyboard, and joystick to customize their response rates. This appendix includes information about sensitivity controls and calibration, as well as instructions for installing one or two joysticks.

Sensitivity Settings

Sensitivity settings control the amount of movement required to make an aircraft respond to changes in pitch, roll, or yaw. Higher sensitivities require less movement; lower sensitivities require more movement. There are two ways to control sensitivities in Flight Simulator; descriptions and procedures follow.

Using Standard Sensitivities

When you accept Flight Simulator's preset sensitivities, controls for the mouse, keyboard, and joystick are set in the middle of the range and the response rate is average. Each situation you open has these settings.

When you change sensitivity settings, the changes you make affect every situation unless you make them situation sensitive.

Using Sensitivities Saved with a Situation

You may want to save the control sensitivities you've set for a particular situation. When you save a situation, Flight Simulator saves the situation's sensitivity settings. If you turn on the Load Sensitivities Saved With Situation option in the General Preferences dialog box, Flight Simulator automatically loads sensitivity settings saved with a situation when you open that situation. In this way, you can customize control devices to your personal preferences.

To load sensitivities saved with a situation

1. From the Options menu, choose Preferences.

   Flight Simulator displays the General Preferences dialog box.

2. Choose the Mouse, Keyboard, or Joystick button.

   Flight Simulator displays the Mouse, Keyboard, or Joystick Preferences dialog box.

3. Choose the Load Sensitivities Saved With Situation check box.

   When you start Flight Simulator, this option is turned off. Choosing it turns it on.

4. Choose the OK button.

Using the Mouse

Click the right mouse button to switch between Pointer and Yoke modes.

In Flight Simulator, you can use the mouse in Pointer mode and Yoke mode. This section explains the differences between these two modes, and describes how you can adjust mouse sensitivity when you are in Yoke mode.

Pointer Mode

In Pointer mode, a pointer arrow is displayed on the screen. You can choose menus, commands, and dialog boxes by clicking them with the left mouse button. You can also adjust some controls and instruments on the instrument panel by clicking them. For example, you can click the flaps position indicator to extend or retract the flaps. On some instruments, such as the OBI, pointing to the left side of the digits and clicking decreases the instrument setting, while pointing to the right side and clicking increases it.

Yoke Mode

If Joystick 1 or 2 is active, it overrides the mouse yoke controls. Mouse pointer functions are still active when joysticks are used.

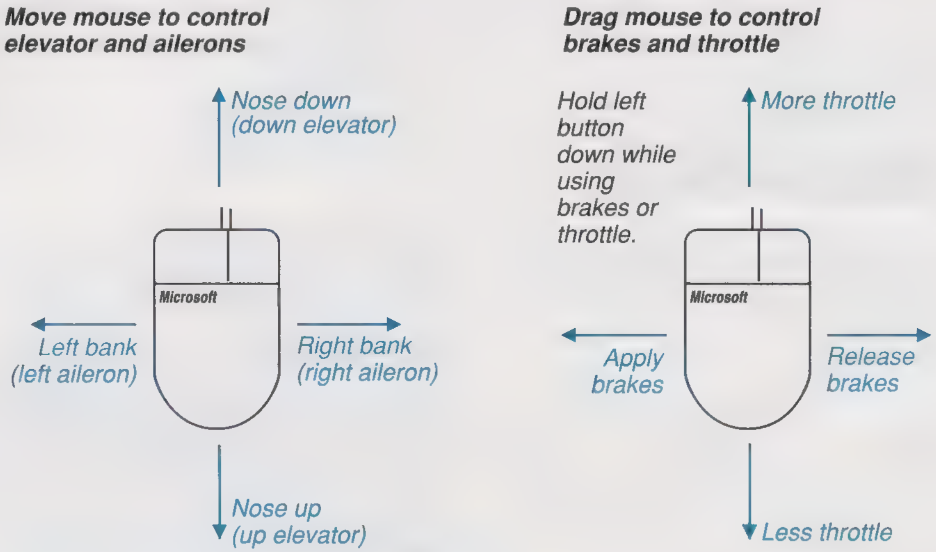
In Yoke mode, you use the mouse as the aircraft control yoke or stick. Movements forward and backward control aircraft pitch (elevator down and elevator up); left and right movements control bank (left or right aileron). The elevator and aileron position indicators on the instrument panel move as you move the mouse.

You operate the propeller and mixture controls, as you do the throttle, by holding down the left mouse button and dragging it forward or backward.

You also control the throttle and brakes by using the mouse in Yoke mode. Hold down the left mouse button and drag the mouse forward or backward to increase or decrease throttle. Hold down the left mouse button and drag the mouse to the left to apply brakes; drag to the right to release them. The throttle indicator on the control panel shows throttle movement (engine rpm also changes as you move the throttle), and a brakes indicator at the lower left of the View 1 (and View 2, if open) window indicates when you have applied brakes.

Mouse Functions in Yoke Mode

Brakes are effective only while your aircraft is on the ground.



To switch between Pointer and Yoke modes

- Click the right mouse button to switch between Pointer and Yoke modes.

When you are in Pointer mode, the mouse pointer is displayed on the screen.

When you are in Yoke mode, the mouse pointer is no longer displayed. You can now change the direction or speed of your aircraft using the mouse.

Adjusting Mouse Sensitivity

You can adjust sensitivity for the mouse by choosing the Preferences command from the Options menu, and then choosing the Mouse button. You can calibrate yoke

sensitivity for the ailerons and the elevator, and for the yoke null zone. Use the mouse to drag the slider controls to the settings you want. Settings to the right give you more sensitivity; settings to the left give you less sensitivity. For example, if you want small mouse movements to have a large effect on the aircraft, drag the slider control to the right of center.

The null zone is provided in the center of control movement to keep the aircraft from slowly drifting into a bank if the ailerons are positioned slightly off-center. As long as the mouse is in this zone, the ailerons are centered. Too wide a null zone gives the ailerons a sloppy feel, while too narrow a zone can make you start banking unintentionally. Experiment to find a balance between these two conditions.

To adjust mouse sensitivity

1. From the Options menu, choose Preferences.

   Flight Simulator displays the General Preferences dialog box.

2. Choose the Mouse button.

   Flight Simulator displays the Mouse Preferences dialog box.

Roll is the movement of the aircraft about its longitudinal axis. Pitch is the movement of the aircraft about its lateral axis (nose up or nose down).

3. To adjust aileron sensitivity, drag the slider control left for less roll sensitivity or right for more roll sensitivity.
4. To adjust elevator sensitivity, drag the slider control left for less pitch sensitivity or right for more pitch sensitivity.
5. To adjust the yoke null zone sensitivity, drag the slider control left for a narrower null zone or right for a wider null zone.
6. Choose the Load Sensitivities Saved With Situation check box if you want to save mouse sensitivities as part of a flight situation and load them whenever you reload that situation.
7. Choose the OK button.

For more information on saving sensitivities and using them, see "Using Sensitivities Saved with a Situation" on page 202.

Using the Keyboard

In Flight Simulator, you can use the keyboard for most control functions. For detailed information on the different keyboards and the keystrokes you can use to control your aircraft, see Appendix D, "Keyboard Summary," on page 239.

Adjusting Keyboard Sensitivity

You can adjust keyboard sensitivities for the ailerons, elevator, and rudder by choosing the Preferences command from the Options menu, and then choosing the Keyboard button. Use the LEFT ARROW and RIGHT ARROW keys or the mouse to move the slider controls to the settings you want. Settings to the right give you more sensitivity; settings to the left give you less sensitivity.

To adjust keyboard sensitivity

1 From the Options menu, choose Preferences.

   Flight Simulator displays the General Preferences dialog box.

2 Choose the Keyboard button.

   Flight Simulator displays the Keyboard Preferences dialog box.

3 To adjust aileron sensitivity, drag the slider control left for less sensitivity or right for more sensitivity.

   You can also press A+ the arrow keys to move the slider control.

4 To adjust elevator sensitivity, drag the slider control left for less sensitivity or right for more sensitivity.

   You can also press E+ the arrow keys to move the slider control.

5 To adjust rudder sensitivity, drag the slider control left for less sensitivity or right for more sensitivity.

   You can also press R+ the arrow keys to move the slider control.

6 Choose the Load Sensitivities Saved With Situation check box if you want to save keyboard sensitivities as part of a flight situation and load them whenever you reload that situation.

   For more information on saving sensitivities and using them, see "Using Sensitivities Saved with a Situation" on page 202.

7 Choose the OK button.

Using Joysticks

In Flight Simulator, you can use one or two joysticks. The joysticks are designated as Joystick 1 and Joystick 2. Joystick 1 is used to control the ailerons and elevator, and Joystick 2 is used to control the throttle and brakes, or the throttle and rudder. If you are using only one joystick, you control the throttle and brakes from the keyboard.

Installing Joysticks

Be sure to follow the manufacturer's installation instructions when installing your joystick or joysticks!

Joysticks are either self-centering, which means that the stick returns to the center position when released, or noncentering. You can control the ailerons and rudder with either a self-centering or noncentering joystick. However, you can only use a noncentering joystick to control the elevator and the throttle.

Many joysticks have mechanical switching levers to turn the self-centering springs on or off. These switches are usually on the underside of the joystick case.

The ideal setup for Flight Simulator joysticks is:

X-axis movement is sideways; Y-axis movement is forward and backward.

- Ailerons (Joystick 1, X-movement), self-centering
- Elevator (Joystick 1, Y-movement), noncentering
- Throttle (Joystick 2, Y-movement), noncentering
- Brakes (Joystick 2, X-movement), self-centering
- Rudder (alternate Joystick 2, X-movement), self-centering

You may be able to turn off the self-centering mechanism on joysticks that do not have switching levers. However, check with your joystick manufacturer before attempting any alteration.

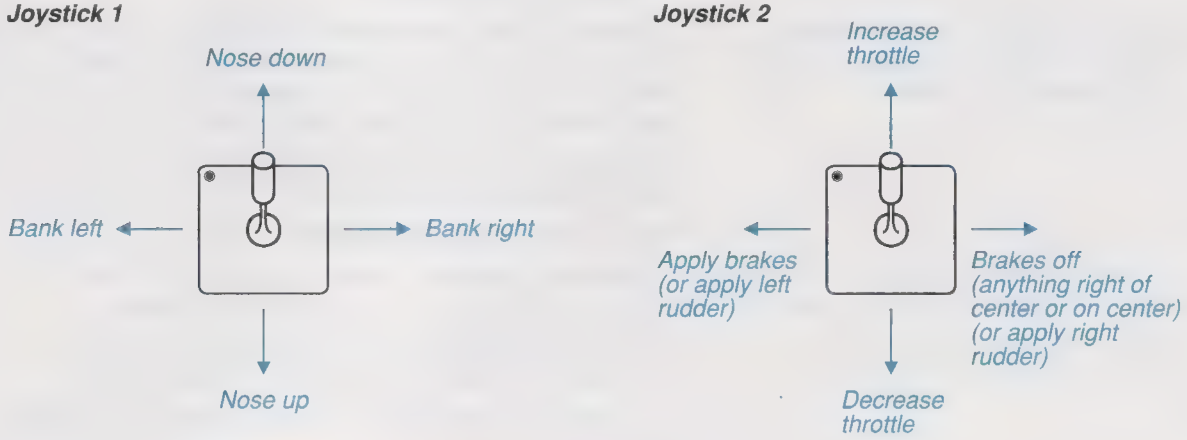
To install a joystick

▶ Turn off your computer and follow the installation instructions included with your joystick or joysticks.

After you've installed the joysticks, you need to activate them and calibrate them for use with Flight Simulator. Each brand of joystick has slight differences in feel, sensitivity, and response. Joystick 1 controls the ailerons and the elevator (and the rudder when the Auto Coordination command on the Sim menu is turned on). Sideways movement (on the X-axis) controls ailerons and roll, and forward and backward movement (on the Y-axis) controls elevator and pitch.

Joystick 2 controls the throttle and brakes or rudder. Full forward provides full throttle, and full back reduces engine speed to an idle. Left motion applies brakes; when the joystick is centered or to the right, the brakes are off.

Joystick Functions



To test Joystick 1 and Joystick 2

1. Turn on your computer and start Flight Simulator.
2. From the Options menu, choose Preferences.

   Flight Simulator displays the General Preferences dialog box.
3. Choose the Joystick button.

   Flight Simulator displays the Joystick Preferences dialog box.
4. Under Joystick 2, choose the Throttle & Brakes or Throttle & Rudder option.

   Joystick 1 automatically controls ailerons and elevator.
5. Choose the OK button.
6. Slowly move Joystick 1 and Joystick 2 through their complete X and Y ranges, watching the movement of the elevator, ailerons, throttle, rudder, and brakes indicators.

The movements may be jumpy, and pushing the stick in a specific direction may not move the control surfaces in that direction. Calibration will solve these problems.

To calibrate Joystick 1

1. From the Options menu, choose Preferences.

   Flight Simulator displays the General Preferences dialog box.

2. Choose the Joystick button.

   Flight Simulator displays the Joystick Preferences dialog box.

3. Move the Joystick 1 aileron and elevator sensitivities to the center position.
4. Center the trim controls, if any (see the instructions included with your joystick).
5. Choose the Calibrate button, and then choose the OK button.

To calibrate Joystick 2

1. From the Options menu, choose Preferences.

   Flight Simulator displays the General Preferences dialog box.

2. Choose the Joystick button.

   Flight Simulator displays the Joystick Preferences dialog box.

3. Under Joystick 2, choose the Throttle & Brakes or Throttle & Rudder option.
4. Center the trim controls, if any (see the instructions included with your joystick).
5. Choose the Calibrate button, and then choose the OK button.

Make sure Joystick 2 is pulled all the way back. If it isn't, the aircraft will begin accelerating as soon as you start your situation.

When Joystick 1 is properly calibrated, the aileron indicator is set full left when the stick is all the way to the left and full right when the stick is all the way to the right. The elevator indicator is set full down when Joystick 1 is all the way forward, and full up when the stick is all the way back. When Joystick 1 is in its center position, the ailerons and elevator are centered.

You can also adjust elevator trim by pressing KEYPAD 1 and KEYPAD 7. For more information, see "Elevator Trim" on page 62.

During flight, you can use any trim controls on the joysticks to make minor adjustments and to keep the controls centered if the calibration drifts.

Now that you have calibrated the joysticks, you can adjust the sensitivity of each joystick action.

Adjusting Joystick Sensitivity

You can adjust sensitivity for the joysticks by choosing the Preferences command from the Options menu, and then choosing the Joystick button. Use the mouse to drag the slider controls to the settings you want. Settings to the right give you more sensitivity; settings to the left give you less sensitivity. For example, if you want

small joystick movements to have a large effect on the aircraft, drag the slider control to the right of center.

The null zone is provided in the center of control movement to keep the aircraft from slowly drifting into a bank if the ailerons are positioned slightly off-center. As long as the joystick is in this zone, the ailerons are centered. Too wide a null zone gives the ailerons a sloppy feel, while too narrow a zone can make you start banking unintentionally. Experiment to find a balance between these two conditions.

To adjust joystick sensitivity

1. From the Options menu, choose Preferences.

   Flight Simulator displays the General Preferences dialog box.

2. Choose the Joystick button.

   Flight Simulator displays the Joystick Preferences dialog box.

3. To adjust Joystick 1 aileron sensitivity, drag the slider control left for less sensitivity or right for more sensitivity.

   You can also press A+ the arrow keys to move the slider control.

4. To adjust Joystick 1 elevator sensitivity, drag the slider control left for less sensitivity or right for more sensitivity.

   You can also press E+ the arrow keys to move the slider control.

5. To adjust Joystick 1 null zone sensitivity, drag the slider control left for a narrower null zone or right for a wider null zone.

   You can also press N+ the arrow keys to move the slider control.

6. To adjust Joystick 2 throttle sensitivity, drag the slider control left for less sensitivity or right for more sensitivity.

   You can also press T+ the arrow keys to move the slider control.

7. To adjust Joystick 2 brake/rudder sensitivity, drag the slider control left for less sensitivity or right for more sensitivity.

   You can also press B+ the arrow keys to move the slider control.

8. To adjust Joystick 2 null zone sensitivity, drag the slider control left for a narrower null zone or right for a wider null zone.

   You can also press Z+ the arrow keys to move the slider control.

9. Choose the Load Sensitivities Saved With Situation check box if you want to save joystick sensitivities as part of a flight situation and load them whenever you reload that situation.

   For more information on saving sensitivities and using them, see "Using Sensitivities Saved with a Situation" on page 202.

10. Choose the OK button.

Appendix B Sectionals, Directories, and Runway Maps

This appendix is divided into seven sections, one for each of the main geographic areas detailed in Flight Simulator: Chicago, Los Angeles, Munich, New York, Paris, San Francisco, and Seattle. Each of these sections includes a sectional map, airport directory, and airport runway maps. The San Francisco sectional is shown in two views. The first is a to-scale map of the most widely used area; the second is a reduced-scale map showing the entire sectional.

Legend

	Civil-Public use airport
Ⓡ	Restricted/Private-Nonpublic use airport, having emergency use or landmark value
☆	Rotating light in operation, sunset to sunrise
NAME CT 124.4 206	Airport name Control Tower (CT)-Primary frequency Elevation in feet
NAME ATIS 118.0	Airport name Automatic Terminal Information Service-Communication radio frequency
NFCT	Non-Federal Control Tower
	VOR (VHF Omni Range)-Civilian navigation board
	VORTAC (VHF Omni Range TACAN)-Civilian and military navigation beacon
JOLIET 112.3	VOR-Navigation radio frequency
VOR (T) KANKAKEE 111.6	VOR(T)-Terminal VOR

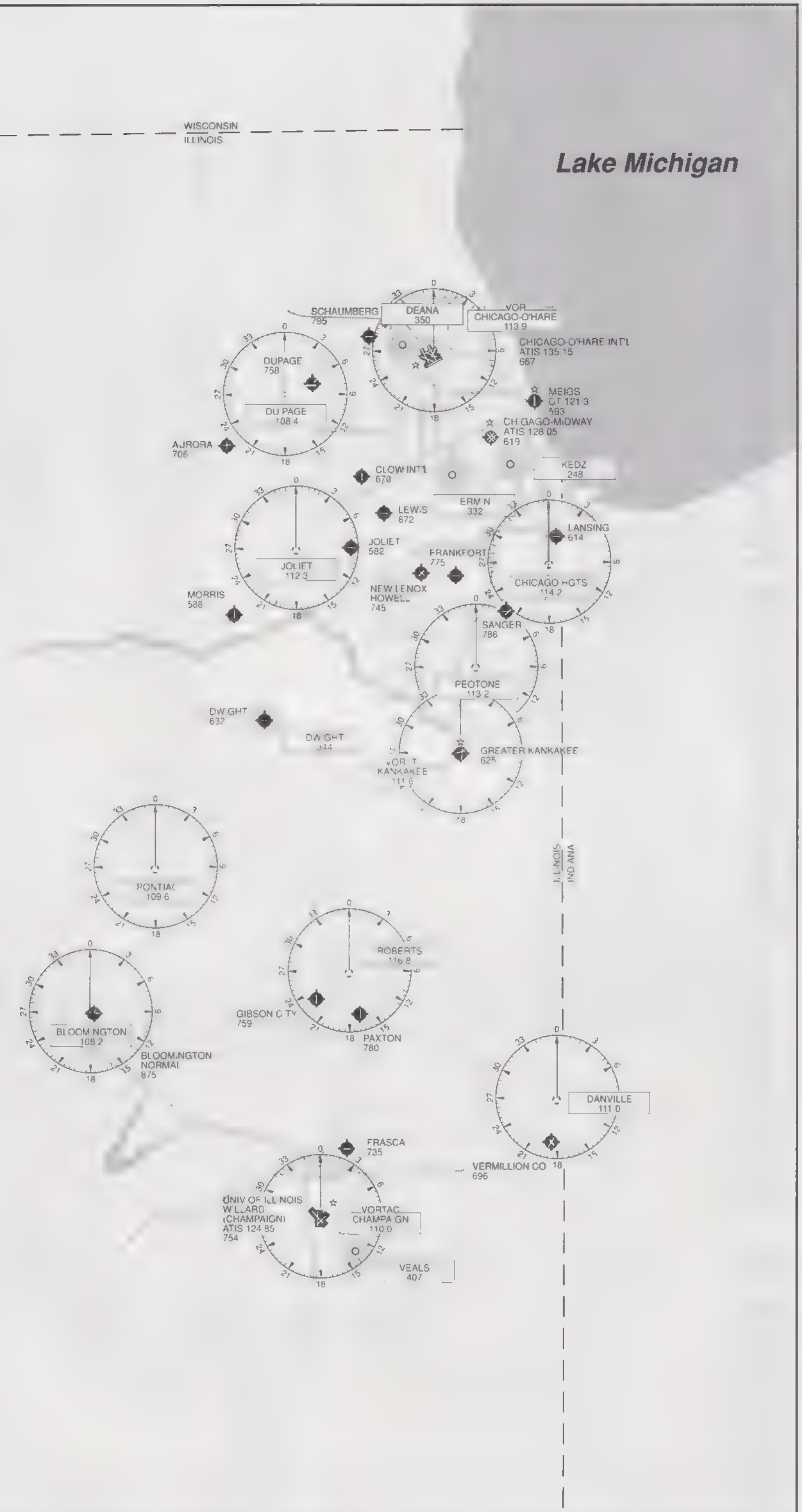
For use with
Microsoft Flight Simulator

NOTAM
Notice to Airmen

See Chicago Sectional Aeronautical Chart for details.

Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.

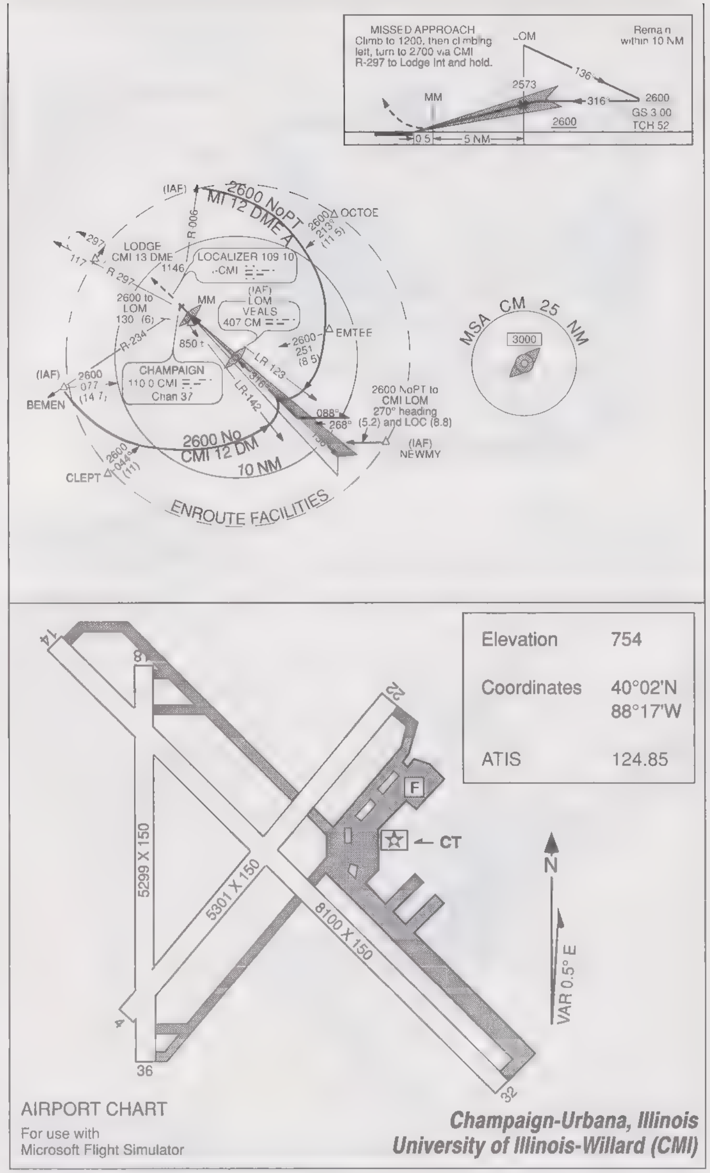
If no ATIS is available (at Meigs, for example), tune in the control-tower frequency (CT) for information.

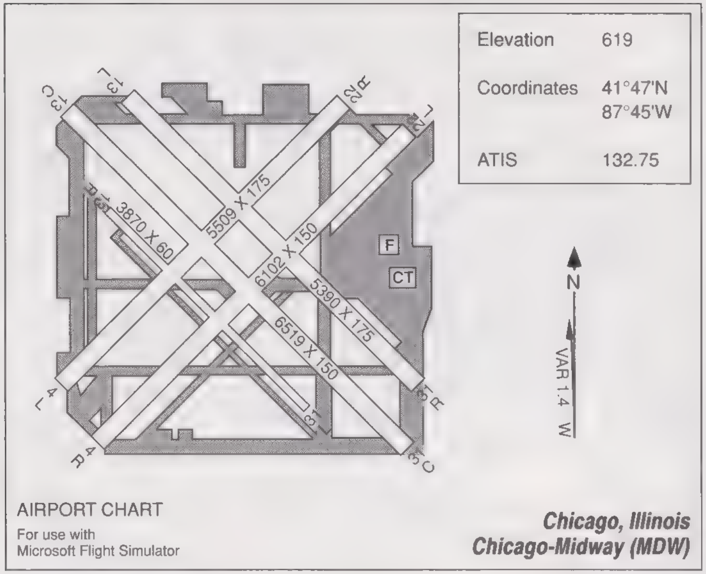


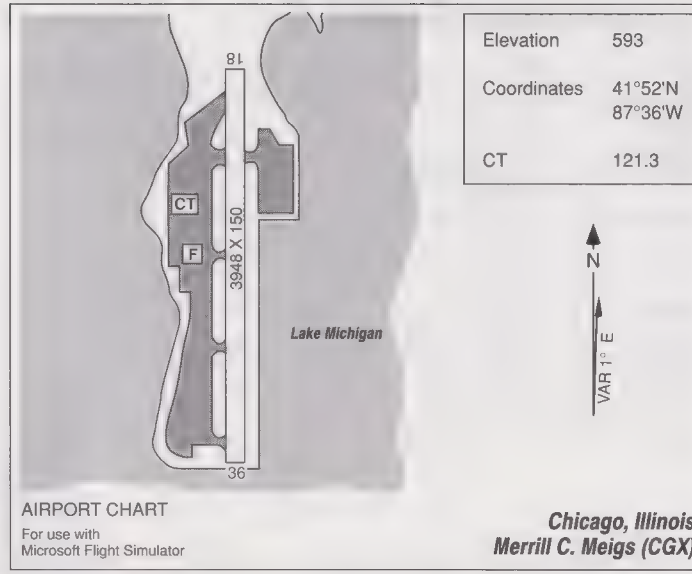
Chicago Sectional Airport Directory

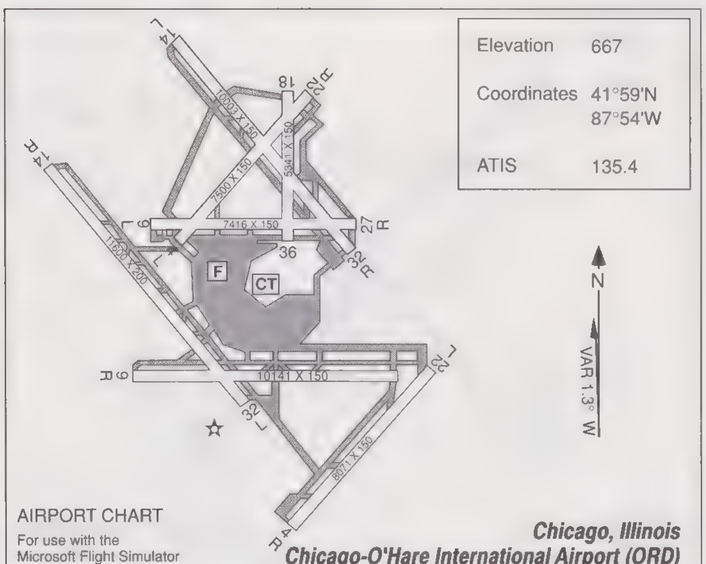
City	Airport	North	West	Elev.	Fuel	ILS
Bloomington/ Normal	Bloomington/ Normal	40°29'	88°55'	875		
Champaign Urbana	Champaign-Urbana/University of Illinois, Willard	40°02'	88°17'	754	*	32L/109.1
Chicago/Aurora	Chicago/Aurora Muni.	41°46'	88°28'	707		32R/110.7
Chicago	Chicago/ Lansing Muni.	41°32'	87°32'	616		
Chicago	Chicago/ Merrill C. Meigs	41°52'	87°36'	593	*	
Chicago	Chicago-Midway	41°47'	87°45'	619	*	
Chicago	Chicago-O'Hare Intl.	41°59'	87°54'	667	*	4L/111.3 4R/110.1 9L/110.5 9R/111.1 14L/110.9 14R/109.7 22L/110.1 22R/111.3 27L/111.1 27R/110.5 32L/109.1 32R/110.7
Chicago	Schamburg Air Park	41°56'	88°06'	797		
Chicago/ Romeoville	Chicago/Lewis University	41°36'	88°05'	668		
Danville	Danville/ Vermillion Co.	40°12'	87°36'	696		
Dwight	Dwight	41°08'	88°26'	632		
Frankfort	Frankfort	41°29'	87°51'	778		
Gibson City	Gibson City Muni.	40°29'	88°16'	758		
Joliet	Joliet Park District	41°31'	88°11'	581		
Kankakee	Kankakee/ Greater Kankakee	41°04'	87°51'	629	*	
Monee	Monee/Sanger	41°32'	87°41'	790		
Morris	Morris Muni.	41°26'	88°25'	588		
New Lenox	New Lenox-Howell	41°29'	87°55'	753		
Paxton	Paxton	40°27'	88°08'	779		
Plainfield	Plainfield/Clow Intl.	41°42'	88°08'	670		
Urbana	Urbana/Frasca Field	40°39'	88°12'	735		
West Chicago	Chicago/DuPage	41°54'	88°15'	758		

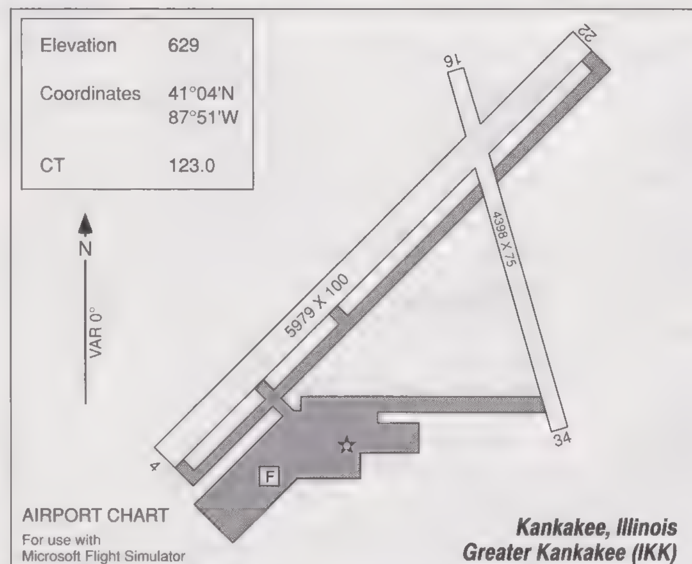
Latitude and longitude coordinates will take you to the airport of your choice but will not necessarily place you on a runway.

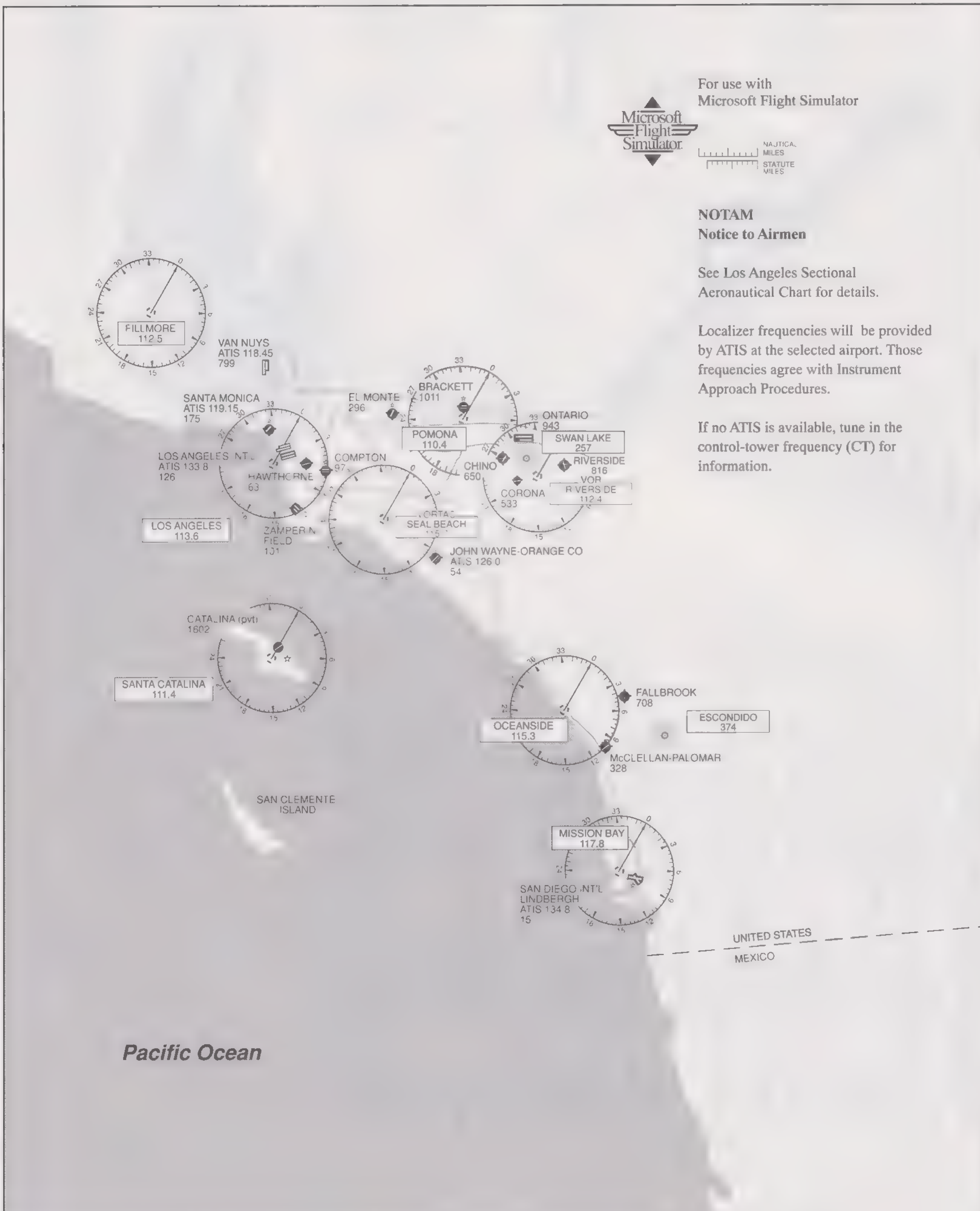



Elevation 619
Coordinates 41°47'N
87°45'W
ATIS 132.75
3870 X 60
5509 X 175
6102 X 150
5390 X 175
6519 X 150
F
CT
N
VAR 1.4 W
AIRPORT CHART
For use with
Microsoft Flight Simulator
Chicago, Illinois
Chicago-Midway (MDW)


Elevation 593
Coordinates 41°52'N
87°36'W
CT 121.3
18
3948 X 150
36
CT
F
Lake Michigan
N
VAR 1° E
AIRPORT CHART
For use with
Microsoft Flight Simulator
Chicago, Illinois
Merrill C. Meigs (CGX)


Elevation 667
Coordinates 41°59'N
87°54'W
ATIS 135.4
10003 X 150
5341 X 150
7500 X 150
7416 X 150
11600 X 200
10141 X 150
8071 X 150
18
36
F
CT
N
VAR 1.3° W
AIRPORT CHART
For use with the
Microsoft Flight Simulator
Chicago, Illinois
Chicago-O'Hare International Airport (ORD)

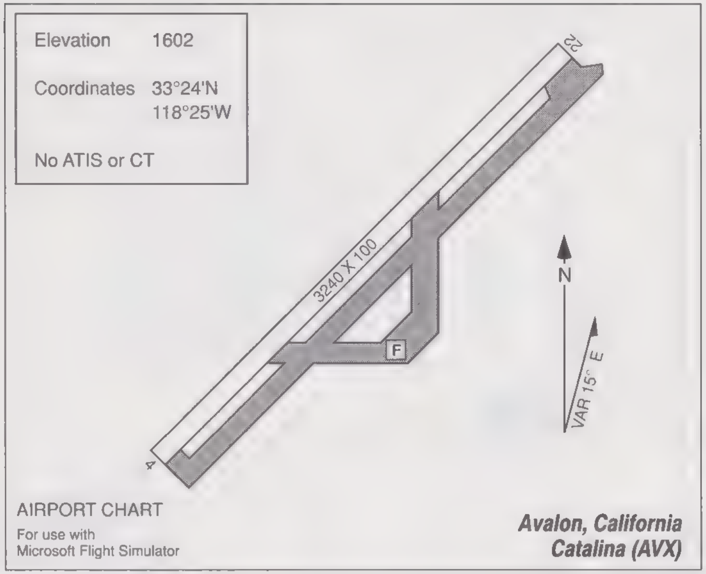

Elevation 629
Coordinates 41°04'N
87°51'W
CT 123.0
16
22
4398 X 75
5979 X 100
34
4
F
N
VAR 0°
AIRPORT CHART
For use with
Microsoft Flight Simulator
Kankakee, Illinois
Greater Kankakee (IKK)

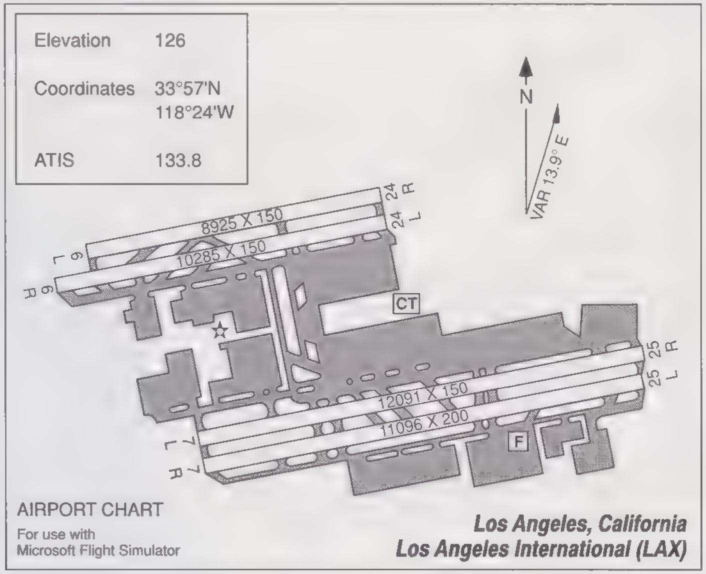

For use with
Microsoft Flight Simulator
Microsoft Flight Simulator
NAUTICAL MILES
STATUTE MILES
NOTAM
Notice to Airmen
See Los Angeles Sectional Aeronautical Chart for details.
Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.
If no ATIS is available, tune in the control-tower frequency (CT) for information.
FILLMORE
112.5
VAN NUYS
ATIS 118.45
799
SANTA MONICA
ATIS 119.15
175
EL MONTE
296
BRACKETT
1011
ONTARIO
943
POMONA
110.4
SWAN LAKE
257
LOS ANGELES INT'L
ATIS 133.8
126
COMPTON
HAWTHORNE
63
CHINO
650
RIVERSIDE
816
CORONA
533
VOR
RIVERSIDE
112.4
LOS ANGELES
113.6
SEAL BEACH
JOHN WAYNE-ORANGE CO
54
CATALINA (pvt)
1602
SANTA CATALINA
111.4
FALLBROOK
708
ESCONDIDO
374
OCEANSIDE
115.3
McCLELLAN-PALOMAR
328
SAN CLEMENTE
ISLAND
MISSION BAY
117.8
SAN DIEGO INT'L
LINDBERGH
ATIS 134.8
15
UNITED STATES
MEXICO
Pacific Ocean

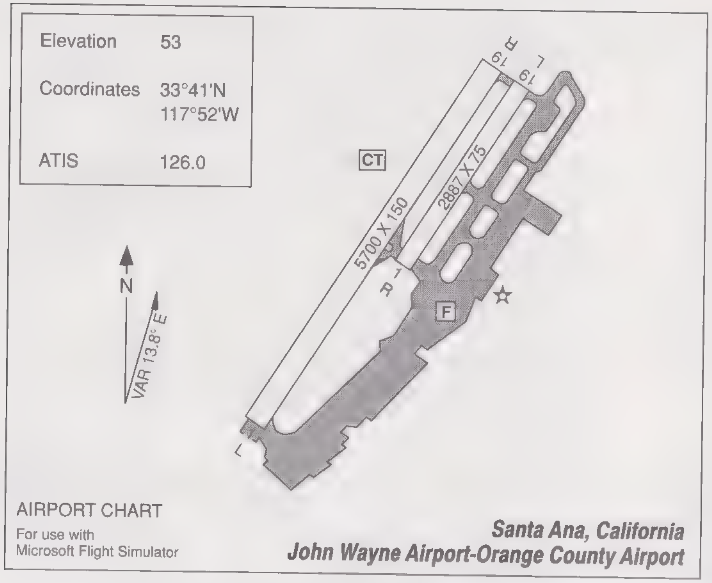
Los Angeles Sectional Airport Directory

City	Airport	North	West	Elev.	Fuel	ILS
Avalon	Catalina (PVT)	33°24'	118°25'	1602	*	
Carlsbad	McClennan-Palomar	33°08'	117°17'	328		
Chino	Chino	33°58'	117°38'	650		
Compton	Compton	33°53'	118°15'	97		
Corona	Corona Municipal	33°54'	117°36'	533		
El Monte	El Monte	34°05'	118°02'	296		
Fallbrook	Fallbrook Community Airpark	33°21'	117°15'	708		
Hawthorne	Hawthorne Municipal	33°55'	118°20'	63		
LaVerne	Brackett Field	34°05'	117°47'	1011		
Los Angeles	Los Angeles Intl.	33°57'	118°24'	126	*	
Oceanside	Oceanside Municipal	33°13'	117 °21'	28		
Ontario	Ontario Intl.	34°03'	117°36'	943		
Riverside	Riverside Municipal	33°57'	117°27'	816		
San Diego	San Diego Intl.-Lindbergh Field.	32°44'	117°11'	15	*	
Santa Ana	John Wayne Airport/Orange Co.	33°41'	117°52'	54	*	
Santa Monica	Santa Monica Municipal	34°01'	118°27'	175	*	
Torrance	Zamperini Field	33°48'	118°20'	101		
Van Nuys	Van Nuys	34°13'	118°29'	799	*	16R/111.3

Latitude and longitude coordinates will take you to the airport of your choice but will not necessarily place you on a runway.



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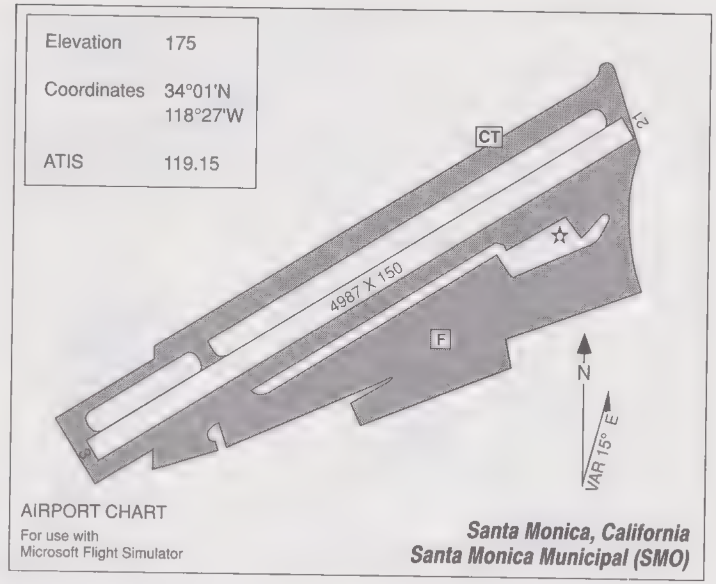
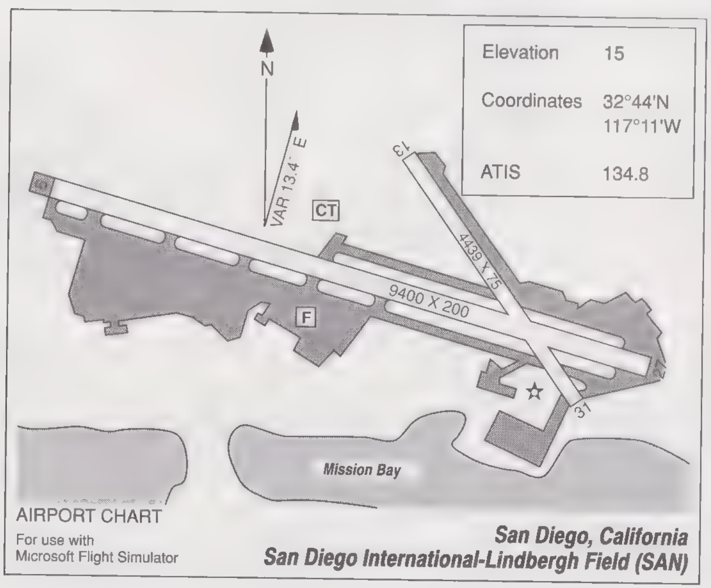
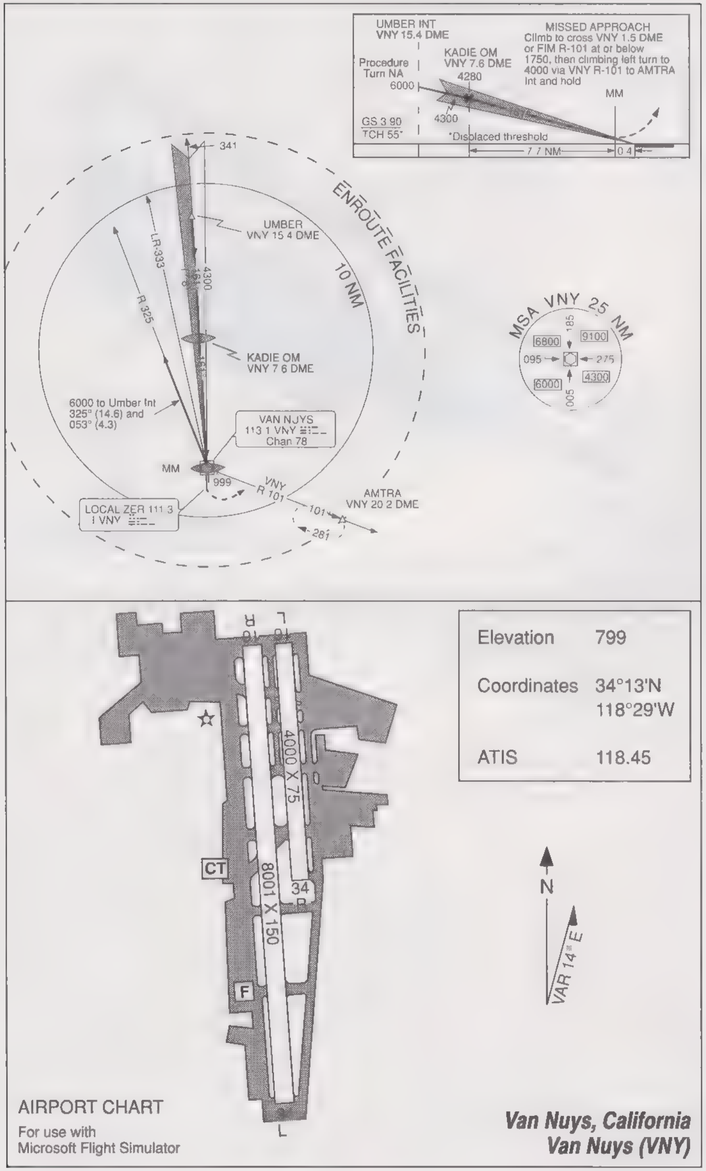
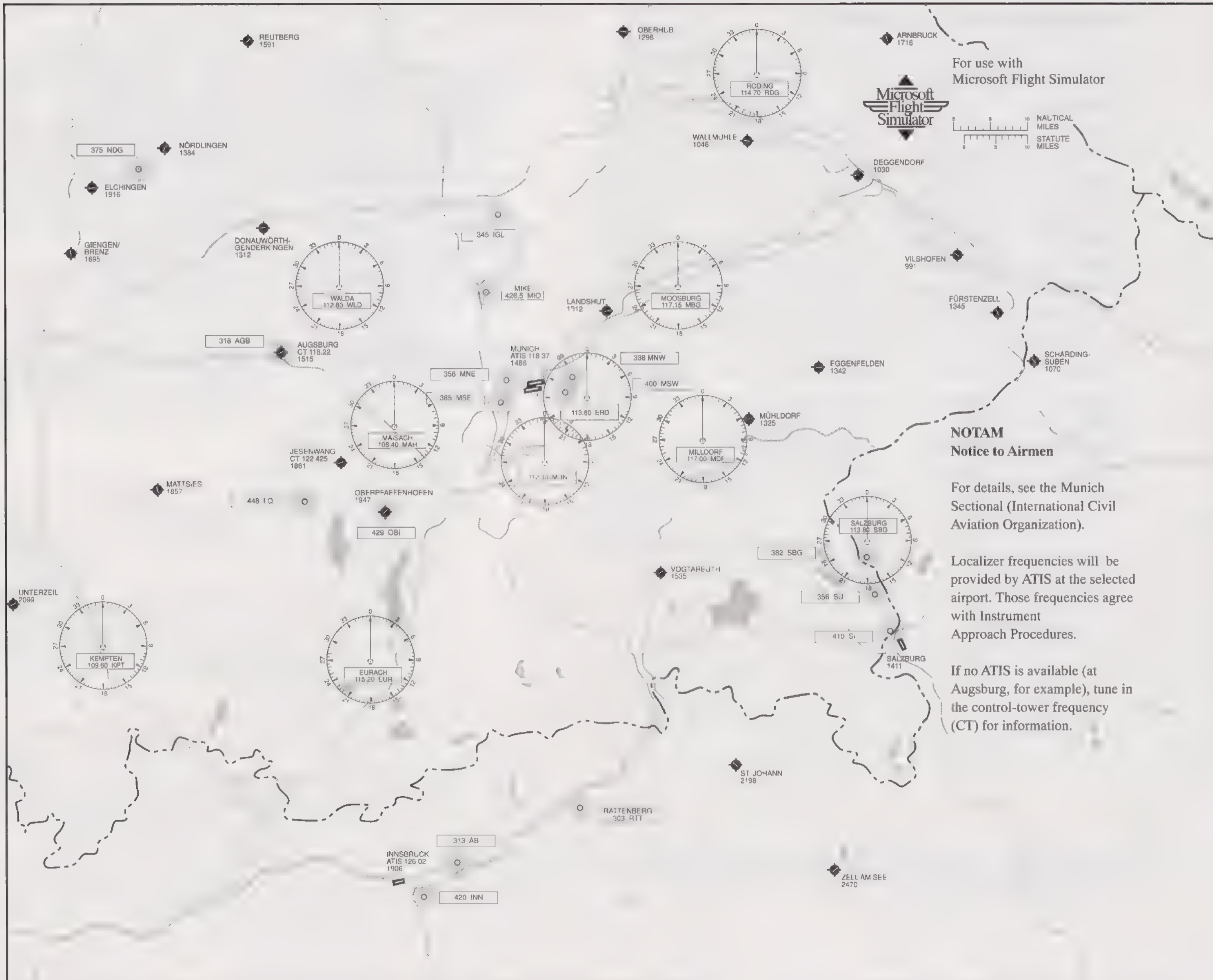
Coordinates 33°41'N 117°52'W
ATIS 126.0
CT
5700 X 150
2887 X 75
19 R
19 L
1 L
1 R
F
N
VAR 13.8° E
AIRPORT CHART
For use with Microsoft Flight Simulator
Santa Ana, California
John Wayne Airport-Orange County Airport


Elevation 175
Coordinates 34°01'N 118°27'W
ATIS 119.15
CT
4987 X 150
21
3
F
N
VAR 15° E
AIRPORT CHART
For use with Microsoft Flight Simulator
Santa Monica, California
Santa Monica Municipal (SMO)


Elevation 15
Coordinates 32°44'N 117°11'W
ATIS 134.8
N
VAR 13.4° E
CT
13
4439 X 75
9400 X 200
F
27
31
Mission Bay
AIRPORT CHART
For use with Microsoft Flight Simulator
San Diego, California
San Diego International-Lindbergh Field (SAN)


UMBER INT
VNY 15.4 DME
KADIE OM
VNY 7.6 DME
Procedure Turn NA
6000
4280
4300
MISSED APPROACH
Climb to cross VNY 1.5 DME or FIM R-101 at or below 1750, then climbing left turn to 4000 via VNY R-101 to AMTRA Int and hold
MM
GS 3.90
TCH 55'
*Displaced threshold
7.7 NM
0.4
341
ENROUTE FACILITIES
10 NM
UMBER
VNY 15.4 DME
LR-333
R-325
4300
161°
KADIE OM
VNY 7.6 DME
6000 to Umber Int 325° (14.6) and 053° (4.3)
VAN NUYS
113.1 VNY
Chan 78
MM
999
VNY R-101
AMTRA
VNY 20.2 DME
101
281
LOCAL ZER 111.3
I-VNY
MSA VNY 25 NM
185
9100
6800
095
275
6000
4300
005
Elevation 799
Coordinates 34°13'N 118°29'W
ATIS 118.45
16 R
16 L
4000 X 75
8001 X 150
34
CT
F
L
N
VAR 14° E
AIRPORT CHART
For use with
Microsoft Flight Simulator
Van Nuys, California
Van Nuys (VNY)


For use with
Microsoft Flight Simulator
Microsoft Flight Simulator
NAUTICAL MILES
STATUTE MILES
REUTBERG 1591
OBERHUB 1298
RODING 114.70 RDG
ARNBRUCK 1718
WALLMUHLE 1046
DEGGENDORF 1030
375 NDG
NÖRDLINGEN 1384
ELCHINGEN 1916
345 IGL
GIENGEN/ BRENZ 1695
DONAUWÖRTH-GENDERKINGEN 1312
WALDA 112.80 WLD
MOOSBURG 117.15 MBG
VILSHOFEN 991
MIKE 428.5 MIO
LANDSHUT 1312
FÜRSTENZELL 1345
318 AGB
AUGSBURG CT 118.22 1515
MUNICH ATIS 118.37 1486
338 MNW
SCHARDING-SUBEN 1070
EGGENFELDEN 1342
358 MNE
385 MSE
400 MSW
113.60 ERD
MAISACH 108.40 MAH
MÜHLDORF 1325
MILLDORF 117.00 MDF
JESENWANG CT 122.425 1861
MATTSIES 1857
448 LQ
OBERPFAFFENHOFEN 1947
429 OBI
SALZBURG 113.80 SBG
382 SBG
VOGTAREUTH 1535
UNTERZEIL 2099
356 SU
KEMPTEN 109.60 KPT
EURACH 115.20 EUR
SALZBURG 1411
ST JOHANN 2198
RATTENBERG 303 RTT
313 AB
INNSBRUCK ATIS 126.02 1906
420 INN
ZELL AM SEE 2470
NOTAM
Notice to Airmen
For details, see the Munich Sectional (International Civil Aviation Organization).
Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.
If no ATIS is available (at Augsburg, for example), tune in the control-tower frequency (CT) for information.

Munich Sectional Airport Directory

City	Airport	North	East	Elev.	Fuel	ILS
Aalen-Heidenheim	Elchingen	48°47'	10°16'	1916		
Arnbruck	Arnbruck	49°08'	12°59'	1716		
Augsburg	Augsburg	48°26'	10°56'	1515	*	
Deggendorf	Deggendorf	48°50'	12°53'	1030		
Donauwörth-Genderkingen	Donauwörth-Genderkingen	48°42'	10°51'	1312		
Eggenfelden	Eggenfelden	48°24'	12°44'	1342		
Fürstenzell	Fürstenzell	48°31'	13°21'	1345		
Giengen/Brenz	Giengen/Brenz	48°38'	10°13'	1695		
Gunzenhausen	Reutberg	49°07'	10°47'	1591		
Innsbruck, Austria	Innsbruck	47°16'	11°21'	1906	*	
Jesenwang	Jesenwang	48°11'	11°08'	1861	*	
Landshut	Landshut	48°31'	12°02'	1312		
Leutkirch	Unterzeil	47°52'	10°01'	2099		
Mindelheim	Mattsies	48°07'	10°32'	1857		
Mühldorf	Mühldorf	48°17'	12°30'	1325		
Munich	Munich	48°21'	11°47'	1486	*	08L/110.3 08R/110.9 26L/108.3 26R/108.7
Nördlingen	Nördlingen	48°52'	10°30'	1384		
Oberpfaffenhofen	Oberpfaffenhofen	48°05'	11°17'	1947		
Regensburg	Oberhub	49°09'	12°05'	1298		
Salzburg, Austria	Salzburg	47°48'	13°00'	1411		
Schärding, Austria	Schärding-Suben	48°24'	13°27'	1070		
St. Johann, Austria	St. Johann	47°31'	12°27'	2198		
Straubing	Wallmühle	48°54'	12°31'	1046		
Vilshofen	Vilshofen	48°38'	13°12'	991		
Vogtareuth	Vogtareuth	47°57'	12°12'	1535		
Zell Am See, Austria	Zell Am See	47°18'	12°47'	2470		

Latitude and longitude coordinates will take you to the airport of your choice but will not necessarily place you on a runway.

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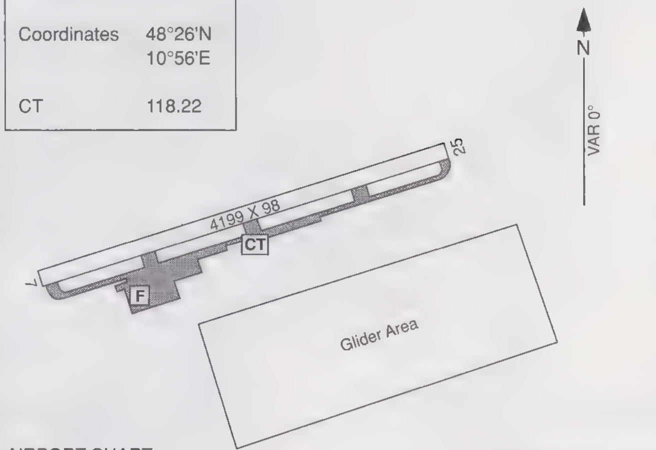
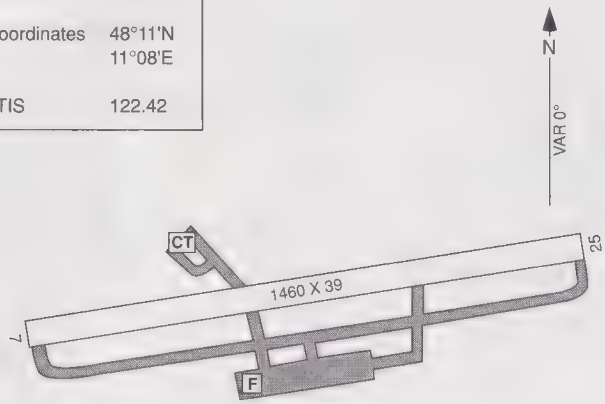
Elevation	1515
Coordinates	48°26'N 10°56'E
CT	118.22



AIRPORT CHART
For use with
Microsoft Flight Simulator

Augsburg, Germany
Augsburg

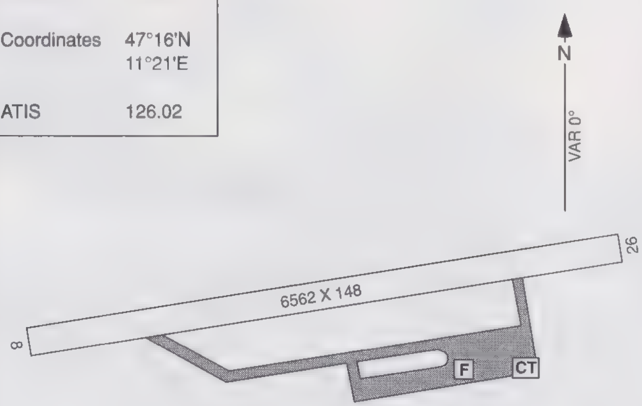
Elevation	1861
Coordinates	48°11'N 11°08'E
ATIS	122.42



AIRPORT CHART
For use with
Microsoft Flight Simulator

Jesenwang, Germany
Jesenwang

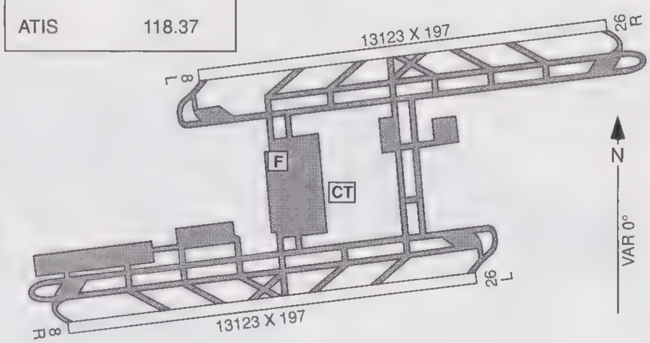
Elevation	1906
Coordinates	47°16'N 11°21'E
ATIS	126.02



AIRPORT CHART
For use with
Microsoft Flight Simulator

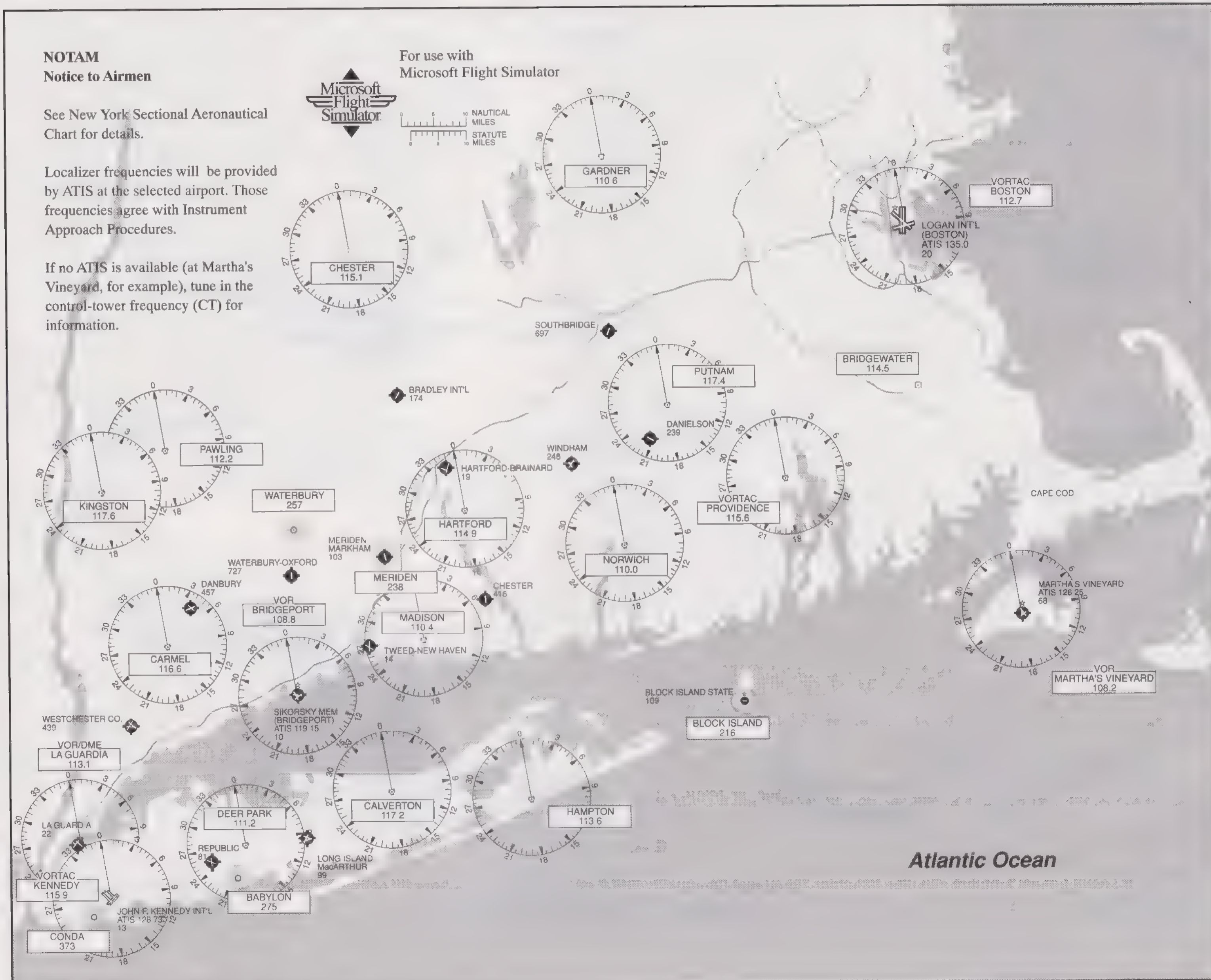
Innsbruck, Austria
Innsbruck

Elevation	1486
Coordinates	48°21'N 11°47'E
ATIS	118.37



AIRPORT CHART
For use with
Microsoft Flight Simulator

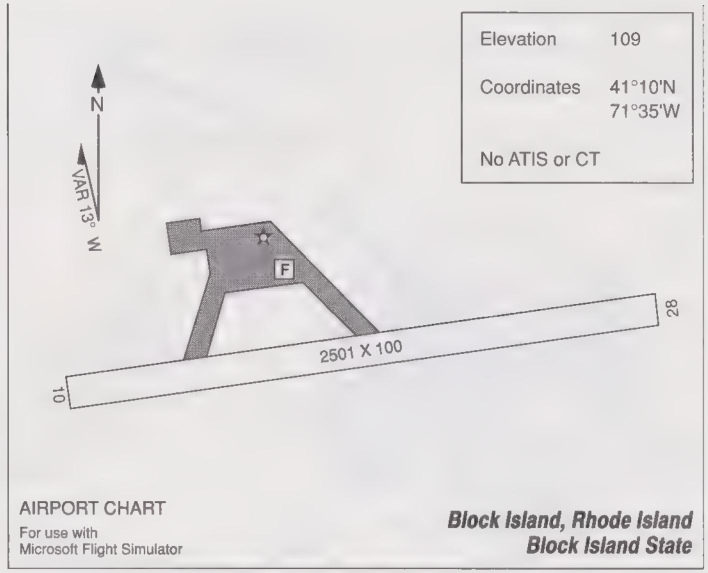
Munich, Germany
Munich

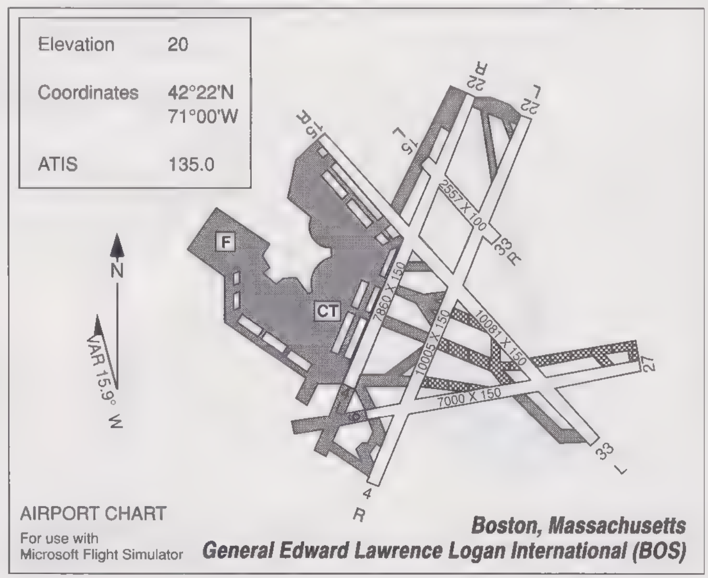

NOTAM
Notice to Airmen
See New York Sectional Aeronautical Chart for details.
Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.
If no ATIS is available (at Martha's Vineyard, for example), tune in the control-tower frequency (CT) for information.
For use with
Microsoft Flight Simulator
Microsoft Flight Simulator
NAUTICAL MILES
STATUTE MILES
GARDNER 110.6
CHESTER 115.1
VORTAC BOSTON 112.7
LOGAN INT'L (BOSTON) ATIS 135.0 20
SOUTHBRIDGE 697
BRIDGEWATER 114.5
PUTNAM 117.4
BRADLEY INT'L 174
DANIELSON 239
PAWLING 112.2
WINDHAM 246
HARTFORD-BRAINARD 19
KINGSTON 117.6
WATERBURY 257
HARTFORD 114.9
VORTAC PROVIDENCE 115.6
CAPE COD
NORWICH 110.0
MERIDEN MARKHAM 103
WATERBURY-OXFORD 727
MERIDEN 238
CHESTER 416
DANBURY 457
MARTHA'S VINEYARD ATIS 126.25 68
VOR BRIDGEPORT 108.8
MADISON 110.4
TWEED-NEW HAVEN 14
CARMEL 116.6
BLOCK ISLAND STATE 109
VOR MARTHA'S VINEYARD 108.2
SIKORSKY MEM (BRIDGEPORT) ATIS 119.15 10
WESTCHESTER CO. 439
BLOCK ISLAND 216
VOR/DME LA GUARDIA 113.1
CALVERTON 117.2
HAMPTON 113.6
DEER PARK 111.2
LA GUARDIA 22
REPUBLIC 81
LONG ISLAND MacARTHUR 99
Atlantic Ocean
VORTAC KENNEDY 115.9
JOHN F. KENNEDY INT'L ATIS 128.73 13
BABYLON 275
CONDA 373

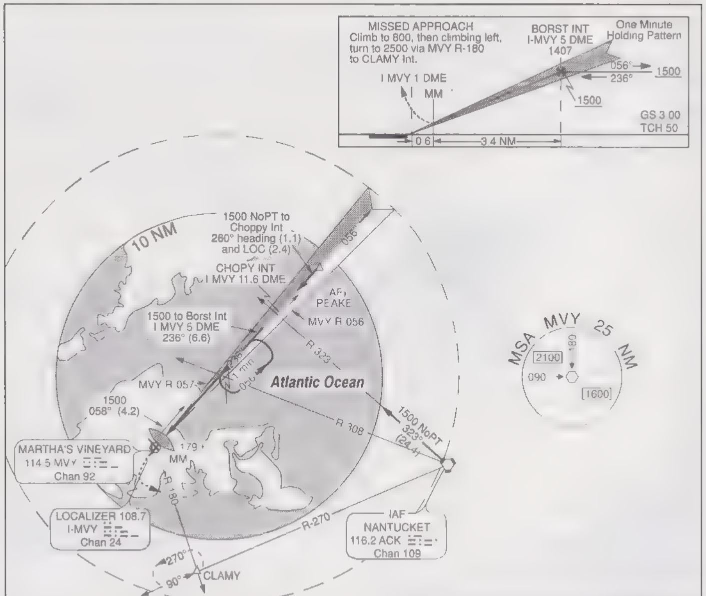
New York Sectional Airport Directory

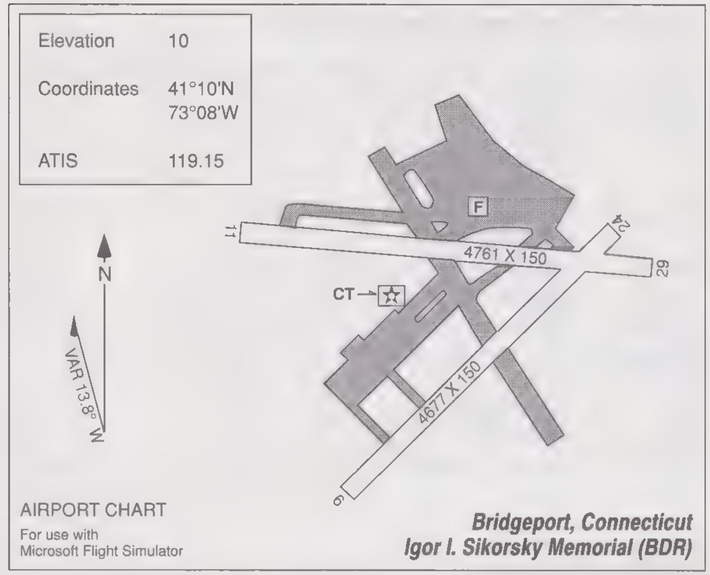
City	Airport	North	West	Elev.	Fuel	ILS
Block Island	Block Island State	41°10'	71°35'	109	*	
Boston	Boston/General Edward Lawrence Logan Intl.	42°22'	71°00'	20	*	
Bridgeport	Bridgeport/Igor I. Sikorsky Memorial	41°10'	73°08'	10	*	
Chester	Chester	41°32'	72°30'	416		
Danbury	Danbury Municipal	41°22'	73°29'	457		
Danielson	Danielson	41°49'	71°54'	238		
Farmingdale	Farmingdale/Republic	40°44'	73°25'	81		
Hartford	Hartford-Brainard	41°44'	72°39'	19		
Islip	Islip/Long Island Mac Arthur	40°48'	73°06'	99		
Martha's Vineyard	Martha's Vineyard	41°24'	70°37'	68	*	24/108.7
Meriden	Meriden Markham Municipal	41°31'	72°50'	103		
New Haven	New Haven/Tweed-New Haven	41°16'	72°53'	14		
New York	New York/John F. Kennedy Intl.	40°38'	73°46'	13	*	
New York	New York/LaGuardia	40°47'	73°52'	22		
Oxford	Oxford/Waterbury-Oxford	41°29'	73°08'	727		
Southbridge	Southbridge Muni.	42°06'	72°02'	697		
White Plains	White Plains/Westchester Co.	41°04'	73°43'	439		
Willimantic	Willimantic/Windham	41°45'	72°11'	247		
Windsor Locks	Windsor Locks/Bradley Intl.	41°56'	72°41'	174		

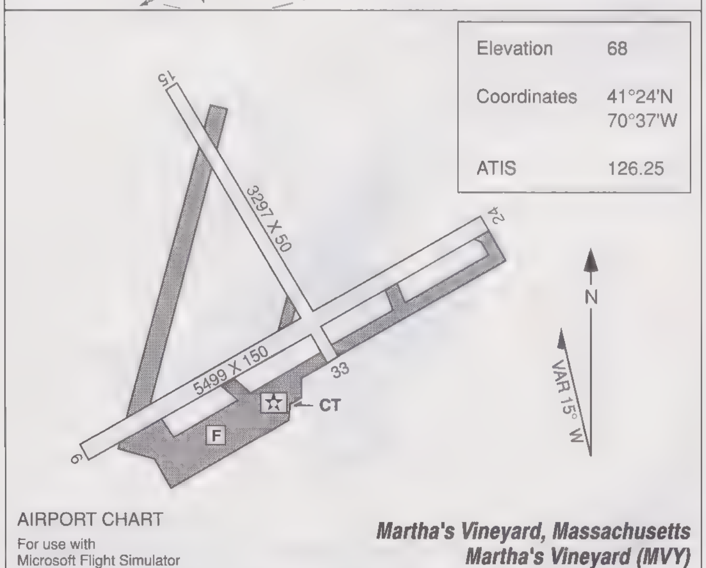
Latitude and longitude coordinates will take you to the airport of your choice but will not necessarily place you on a runway.

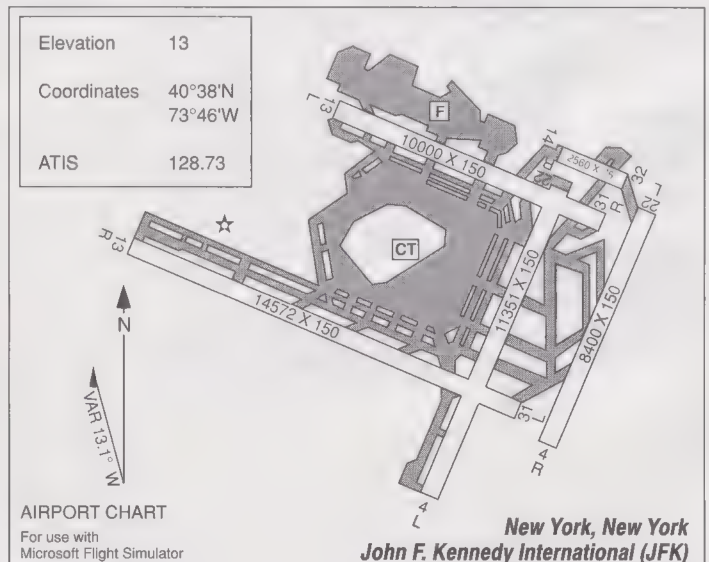


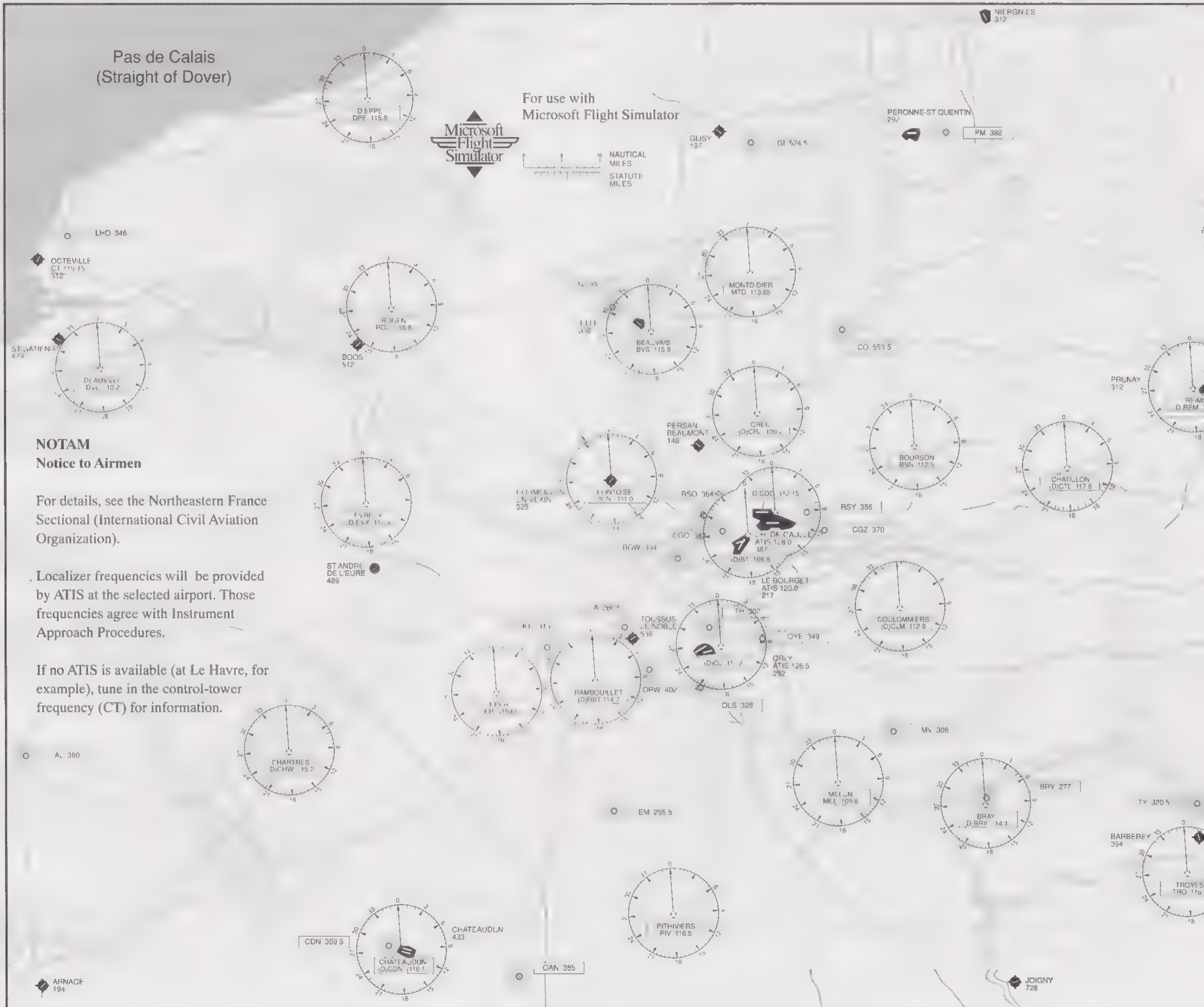



MISSED APPROACH
Climb to 800, then climbing left, turn to 2500 via MVY R-180 to CLAMY Int.
BORST INT
I-MVY 5 DME
1407
One Minute Holding Pattern
I MVY 1 DME
MM
056°
236°
1500
1500
GS 3.00
TCH 50
0.6
3.4 NM
10 NM
1500 NoPT to Choppy Int 260° heading (1.1) and LOC (2.4)
CHOPY INT
I MVY 11.6 DME
AF PEAKE
MVY R 056
1500 to Borst Int
I MVY 5 DME
236° (6.6)
R 323
MVY R 057
Atlantic Ocean
1500
058° (4.2)
R 308
1500 NoPT 323° (24.4)
MARTHA'S VINEYARD
114.5 MVY
Chan 92
MM
R 180
LOCALIZER 108.7
I-MVY
Chan 24
R-270
IAF
NANTUCKET
116.2 ACK
Chan 109
270°
90°
CLAMY
MSA MVY 25 NM
2100
1600
090
180


Elevation 10
Coordinates 41°10'N 73°08'W
ATIS 119.15
N
VAR 13.8° W
F
11
29
24
6
4761 X 150
4677 X 150
CT
AIRPORT CHART
For use with
Microsoft Flight Simulator
Bridgeport, Connecticut
Igor I. Sikorsky Memorial (BDR)


Elevation 68
Coordinates 41°24'N 70°37'W
ATIS 126.25
15
3297 X 50
24
5499 X 150
33
CT
F
6
N
VAR 15° W
AIRPORT CHART
For use with
Microsoft Flight Simulator
Martha's Vineyard, Massachusetts
Martha's Vineyard (MVY)

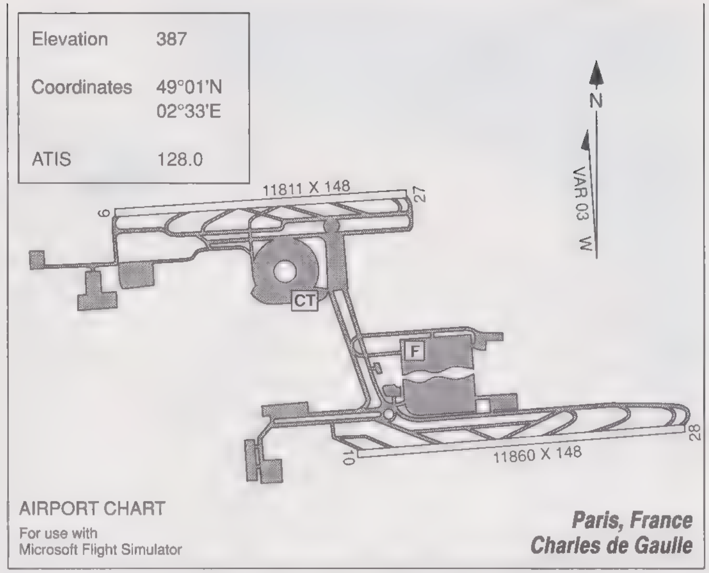

Elevation 13
Coordinates 40°38'N 73°46'W
ATIS 128.73
13 L
F
10000 X 150
14
32
31 R
22 R
13 R
CT
14572 X 150
11351 X 150
8400 X 150
31 L
4 R
4 L
N
VAR 13.1° W
AIRPORT CHART
For use with
Microsoft Flight Simulator
New York, New York
John F. Kennedy International (JFK)

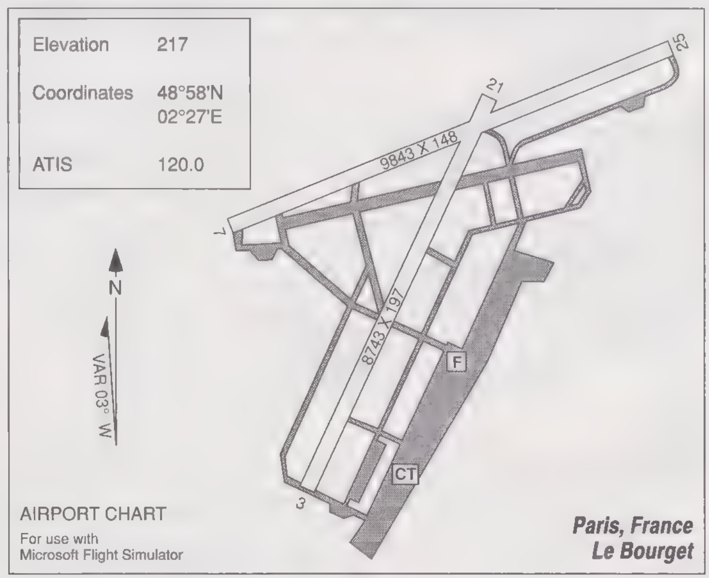

Pas de Calais
(Straight of Dover)
For use with
Microsoft Flight Simulator
Microsoft Flight Simulator
NAUTICAL MILES
STATUTE MILES
DIEPPE DPE 115.8
PERONNE-ST QUENTIN 292
PM 382
GLISY 197
LHO 346
OCTEVILLE
ROUEN
BOOS 512
DEAUVILLE
MONTDIDIER MTD 113.65
BEAUVAIS BVS 115.9
CO 553.5
CREIL
PERSAN BEAUMONT 148
PONTOISE
BOURSON BSN 112.5
CHATILLON (D)CTL 117.6
PRUNAY 312
RSO 364
RSY 356
CGZ 370
CGO
BGW 334
ATIS
LE BOURGET
ST ANDRE DE L'EURE 489
COULOMMIERS
TOUSSUS LE NOBLE
OYE 349
ORLY ATIS 126.5 292
RAMBOUILLET (D)RBT 114.7
ORW 402
OLS 328
MV 308
CHARTRES
MELUN MEL 109.8
BRAY
BRY 277
BARBEREY 394
EM 295.5
PITHIVIERS PIV 116.5
CDN 359.5
CHATEAUDUN 433
CHATEAUDUN
OAN 385
ARNAGE 194
JOIGNY 728
NOTAM
Notice to Airmen
For details, see the Northeastern France Sectional (International Civil Aviation Organization).
Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.
If no ATIS is available (at Le Havre, for example), tune in the control-tower frequency (CT) for information.

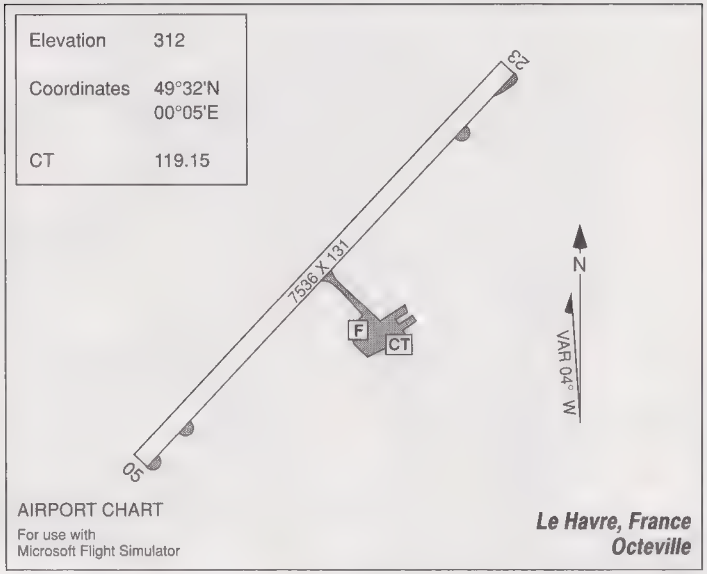
Paris Sectional Airport Directory

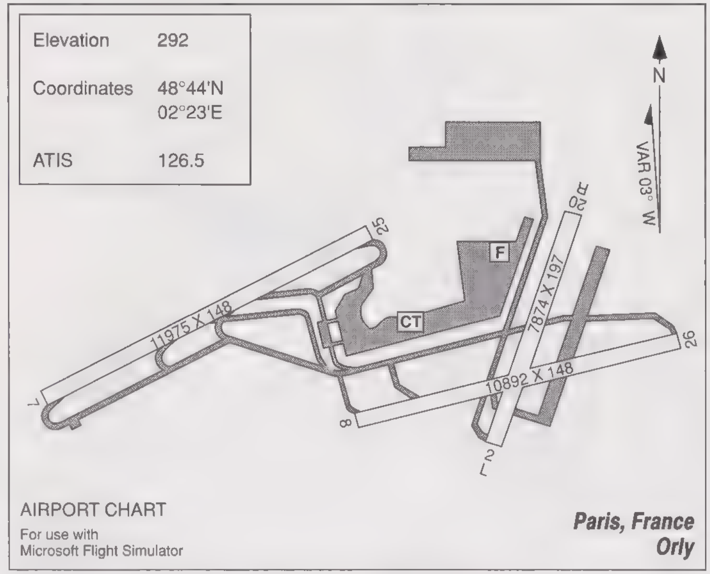
City	Airport	North	East	Elev.	Fuel	ILS
Amiens	Glisy	49°52'	02°23'	197		
Beauvais	Tille	49°27'	02°07'	358		
Cambrai	Niergnies	50°09'	03°16'	312		
Châteaudun	Châteaudun	48°04'	01°23'	433		
Deauville	St. Gatien	49°22'	00°10'	479		
Joigny	Joigny	47°60'	03°24'	728		
Le Havre	Octeville	49°32'	00°05'	312	*	
Le Mans	Arnage	47°57'	00°12'	194		
Paris	Charles-de-Gaulle	49°01'	02°33'	387	*	09/110.1 10/108.7 27/110.7 28/109.1
Paris	Le Bourget	48°59'	02°27'	217	*	
Paris	Orly	48°44'	02°23'	292	*	02L/110.3 07/108.5 25/110.9 26/109.5
Peronne-St. Quentin	Peronne-St. Quentin	49°52'	03°02'	292		
Persan-Beaumont	Persan-Beaumont	49°10'	02°19'	148		
Pontoise	Cormeilles-en-Vexin	49°06'	02°03'	325		
Reims	Prunay	49°13'	04°09'	312		
Rouen	Boos	49°24'	01°11'	512		
St André de l'Eure	St André de l'Eure	48°54'	01°15'	489		
Toussus-le-Noble	Toussus-le-Noble	48°45'	02°07'	538		
Troyes	Barberey	48°19'	04°01'	394		

Latitude and longitude coordinates will take you to the airport of your choice but will not necessarily place you on a runway.









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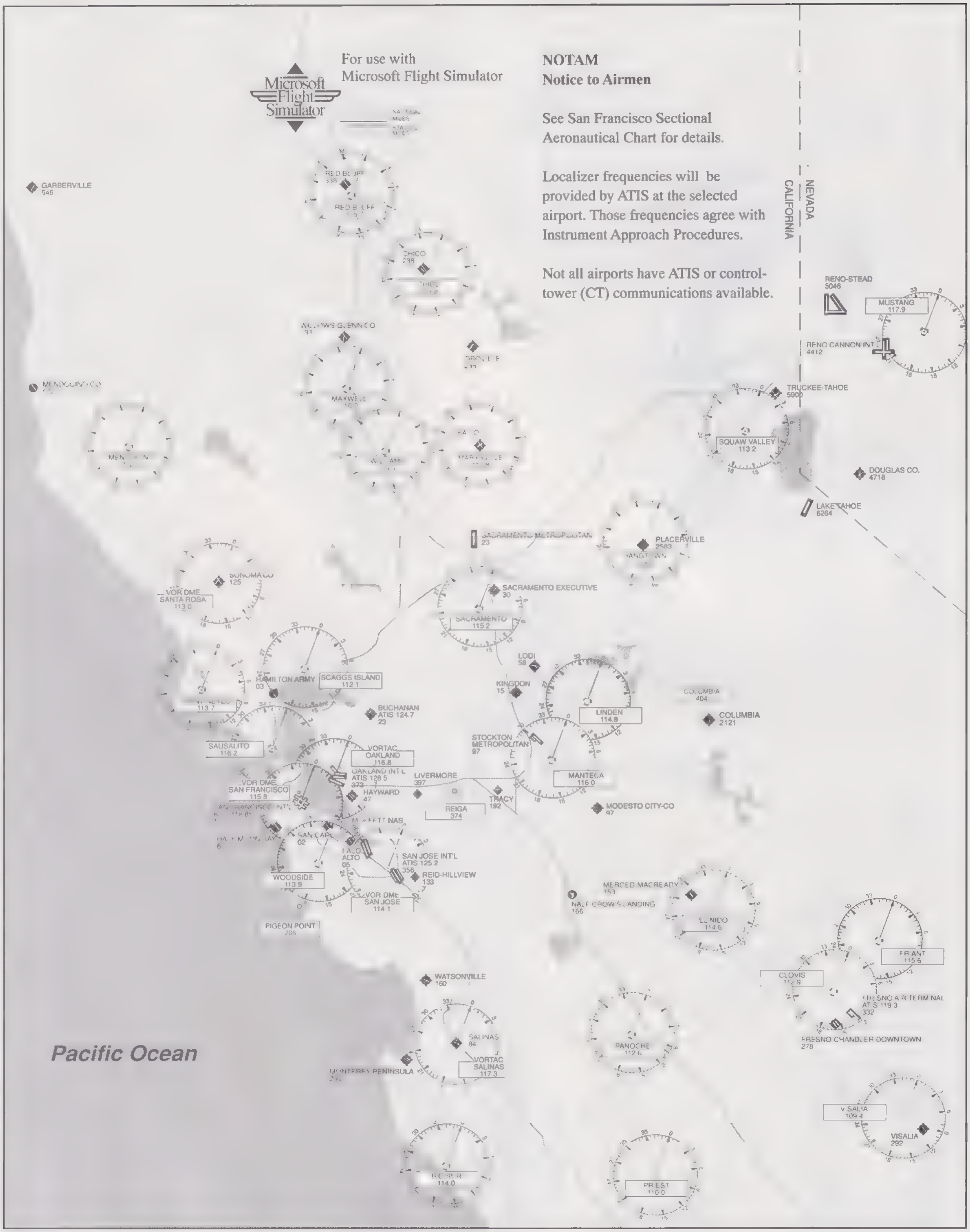
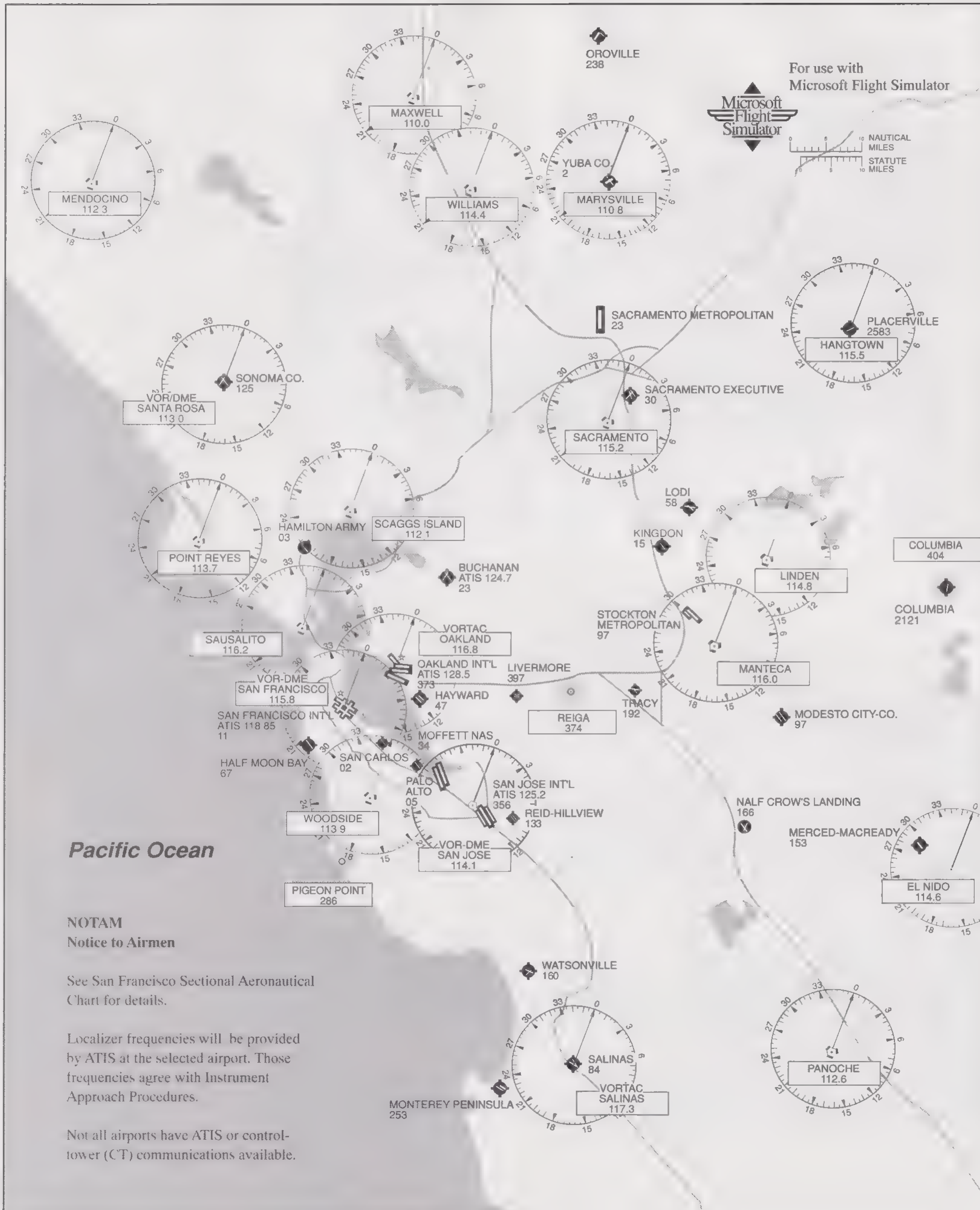
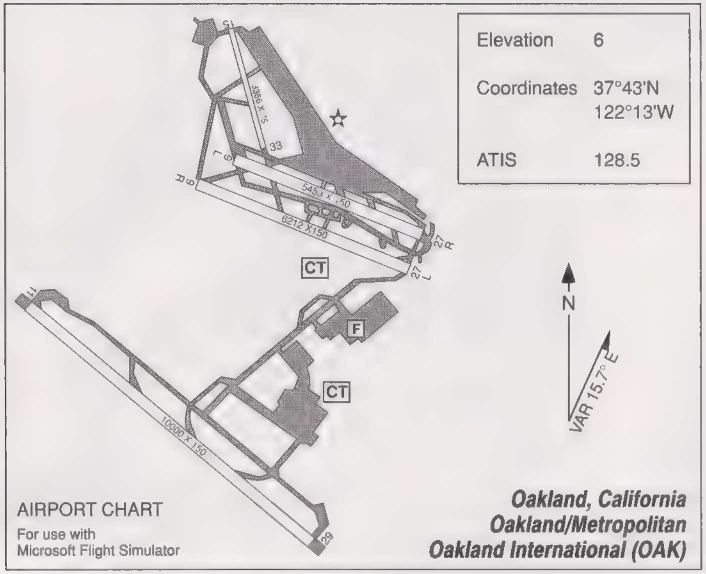

For use with
Microsoft Flight Simulator
NOTAM
Notice to Airmen
See San Francisco Sectional Aeronautical Chart for details.
Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.
Not all airports have ATIS or control-tower (CT) communications available.
NEVADA
CALIFORNIA
GARBERVILLE 546
RENO-STEAD 5046
MUSTANG 117.9
RENO CANNON INT'L 4412
TRUCKEE-TAHOE 5900
SQUAW VALLEY 113.2
DOUGLAS CO. 4718
LAKE TAHOE 6264
PLACERVILLE 2583
SACRAMENTO EXECUTIVE 30
SACRAMENTO 115.2
SONOMA CO 125
VOR DME SANTA ROSA 113.0
LODI 58
KINGDON 15
LINDEN 114.8
COLUMBIA 2121
HAMILTON ARMY 03
SCAGGS ISLAND 112.1
BUCHANAN ATIS 124.7 23
SAUSALITO 116.2
VORTAC OAKLAND 116.8
STOCKTON METROPOLITAN 97
LIVERMORE 397
HAYWARD 47
VOR DME SAN FRANCISCO 115.8
TRACY 192
REIGA 374
MANTECA 116.0
MODESTO CITY-CO 97
SAN JOSE INT'L ATIS 125.2 356
REID-HILLVIEW 133
WOODSIDE 113.9
VOR DME SAN JOSE 114.1
PIGEON POINT 286
EL NIDO 114.6
CLOVIS 112.9
WATSONVILLE 160
SALINAS 84
VORTAC SALINAS 117.3
PANOCHE 112.6
FRESNO CHANDLER DOWNTOWN 278
VISALIA 109.4
VISALIA 292
BIG SUR 114.0
PRIEST 110.0
Pacific Ocean


OROVILLE
238
For use with
Microsoft Flight Simulator
Microsoft Flight Simulator
NAUTICAL MILES
STATUTE MILES
MAXWELL
110.0
MENDOCINO
112 3
WILLIAMS
114.4
YUBA CO.
2
MARYSVILLE
110 8
SACRAMENTO METROPOLITAN
23
PLACERVILLE
2583
HANGTOWN
115.5
SONOMA CO.
125
VOR/DME
SANTA ROSA
113 0
SACRAMENTO EXECUTIVE
30
SACRAMENTO
115.2
LODI
58
KINGDON
15
HAMILTON ARMY
03
SCAGGS ISLAND
112 1
POINT REYES
113.7
BUCHANAN
ATIS 124.7
23
COLUMBIA
404
LINDEN
114.8
COLUMBIA
2121
STOCKTON
METROPOLITAN
97
SAUSALITO
116.2
VORTAC
OAKLAND
116.8
OAKLAND INT'L
ATIS 128.5
373
LIVERMORE
397
VOR-DME
SAN FRANCISCO
115.8
HAYWARD
47
MANTECA
116.0
TRACY
192
MODESTO CITY-CO.
97
REIGA
374
SAN FRANCISCO INT'L
ATIS 118 85
11
MOFFETT NAS
34
HALF MOON BAY
67
SAN CARLOS
02
PALO
ALTO
05
SAN JOSE INT'L
ATIS 125.2
356
REID-HILLVIEW
133
NALF CROW'S LANDING
166
MERCED-MACREADY
153
WOODSIDE
113 9
VOR-DME
SAN JOSE
114.1
Pacific Ocean
EL NIDO
114.6
PIGEON POINT
286
NOTAM
Notice to Airmen
See San Francisco Sectional Aeronautical Chart for details.
Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.
Not all airports have ATIS or control-tower (CT) communications available.
WATSONVILLE
160
SALINAS
84
VORTAC
SALINAS
117.3
PANOCHE
112.6
MONTEREY PENINSULA
253

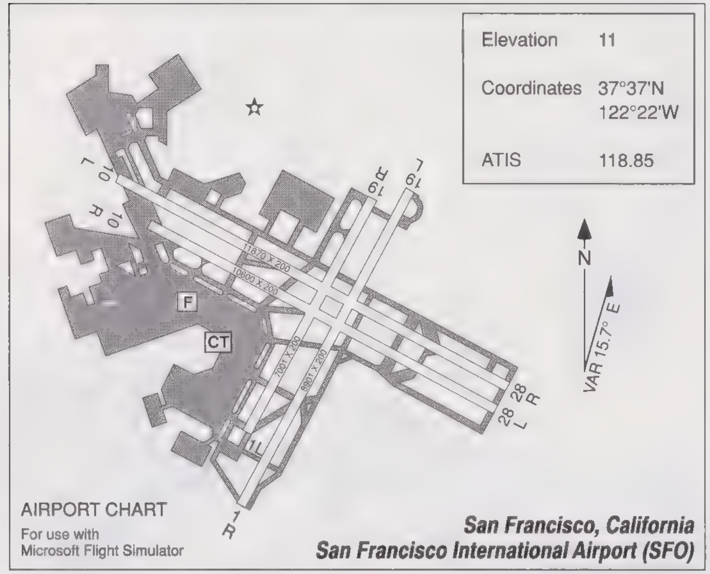
San Francisco Sectional Airport Directory

City	Airport	North	West	Elev.	Fuel	ILS
Chico	Chico Municipal	39°48'	121°51'	238		
Colombia	Colombia	38°02'	120°25'	2118		
Concord	Buchanan Fld.	37°59'	122°03'	23		
Crows Landing	NALF Crows Landing	37°25'	121°06'	166		
Fresno	Chandler Downtown	36°44'	119°49'	278		
Fresno	Fresno Air Terminal	36°47'	119°43'	333		
Garberville	Garberville	40°05'	123°49'	546		
Half Moon Bay	Half Moon Bay	37°31'	122°30'	67		
Hayward	Hayward Air Terminal	37°40'	122°07'	47		
Little River	Mendocino Co.	39°15'	123°45'	572		
Livermore	Livermore Muni.	37°42'	121°49'	397		
Lodi	Kingdon	38°06'	121°22'	15		
Lodi	Lodi	38°12'	121°16'	58		
Marysville	Yuba Co.	39°06'	121°34'	62		
Merced	Merced Municipal-Macready Fld.	37°17'	120°31'	153		
Minden	Douglas Co.	39°00'	119°45'	4718		
Modesto	Modesto City	37°38'	120°57'	97		
Monterey	Monterey Peninsula	36°35'	121°51'	254		
Mountain View	NAS Moffett	37°19'	122°09'	34		
Novato	Hamilton	38°04'	122°31'	3		
Oakland	Metro Oakland Intl.	37°43'	122°13'	6	*	11/111.9 27R/109.9 29/108.7
Oakland	NAS Alameda	37°47'	122°19'			
Oroville	Oroville Muni.	39°29'	121°37'	190		
Palo Alto	Palo Alto	37°28'	122°07'	5		
Placerville	Placerville	38°43'	120°45'	2583		
Red Bluff	Red Bluff Muni.	40°09'	122°15'	349		
Reno	Reno Cannon Intl.	39°30'	119°46'	4412		
Reno	Reno/Stead	39°40'	119°52'	5046		
Sacramento	Sacramento Metro	38°42'	121°35'	24		
Sacramento	Sacramento Exec.	38°31'	121°30'	21		
Salinas	Salinas Muni.	36°40'	121°36'	84		
San Carlos	San Carlos	37°31'	122°15'	2		
San Francisco	San Francisco Intl.	37°37'	122°22'	11	*	
San Jose	Reid-Hillview	37°20'	121°49'	133		
San Jose	San Jose Intl.	37°22'	121°56'	56		
Santa Rosa	Santa Rosa/ Sonoma Co.	38°31'	122°49'	125		
South Lake Tahoe	South Lake Tahoe/ Lake Tahoe	38°54'	120°00'	6264		
Stockton	Stockton Metro	37°54'	121°14'	30		
Truckee	Truckee-Tahoe	39°19'	120°08'	5900		
Visalia	Visalia Muni.	36°19'	119°24'	292		
Watsonville	Watsonville Muni.	36°56'	121°47'	160		
Willows	Willows-Glenn Co.	39°31'	122°13'	139		

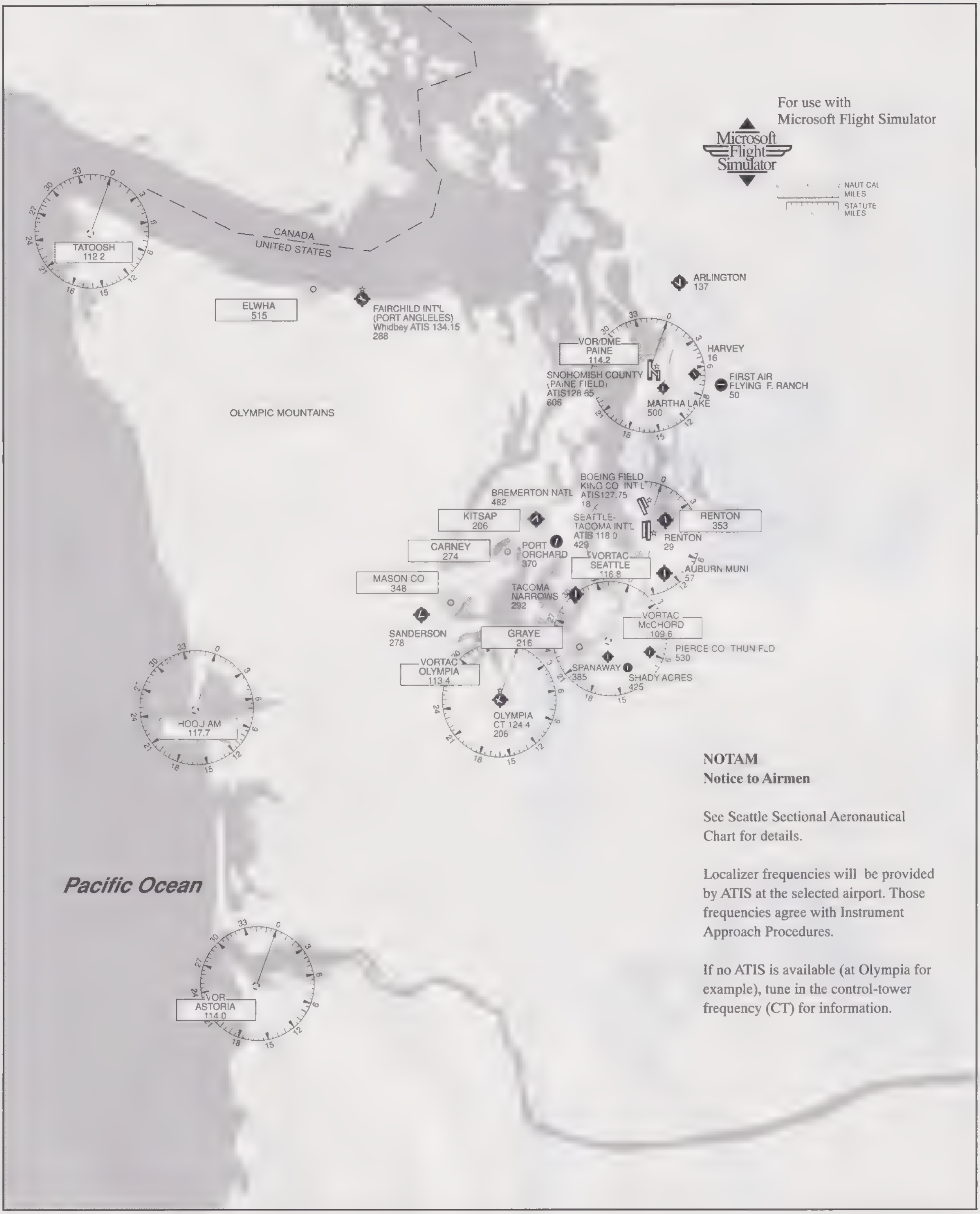
Latitude and longitude coordinates will take you to the airport of your choice but will not necessarily place you on a runway.



Elevation 6
Coordinates 37°43'N 122°13'W
ATIS 128.5
CT
F
CT
N
VAR 15.7° E
AIRPORT CHART
For use with
Microsoft Flight Simulator
Oakland, California
Oakland/Metropolitan
Oakland International (OAK)



Elevation 11
Coordinates 37°37'N 122°22'W
ATIS 118.85
F
CT
N
VAR 15.7° E
AIRPORT CHART
For use with
Microsoft Flight Simulator
San Francisco, California
San Francisco International Airport (SFO)



NOTAM
Notice to Airmen

See Seattle Sectional Aeronautical Chart for details.

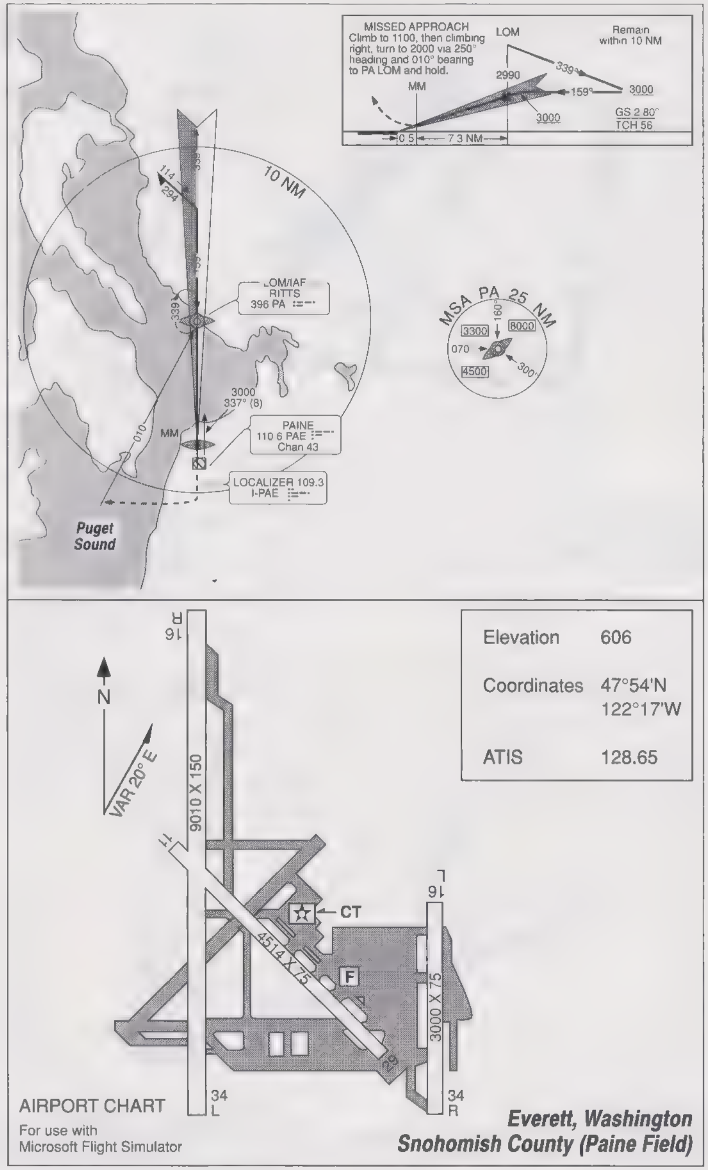
Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.

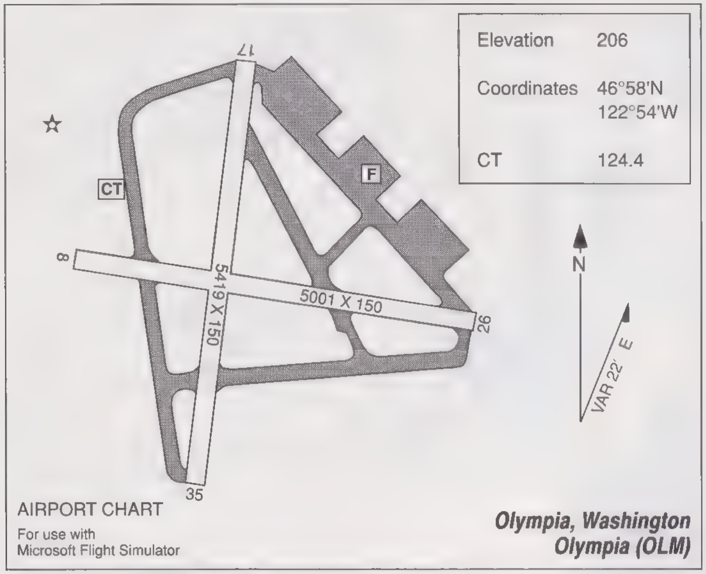
If no ATIS is available (at Olympia for example), tune in the control-tower frequency (CT) for information.

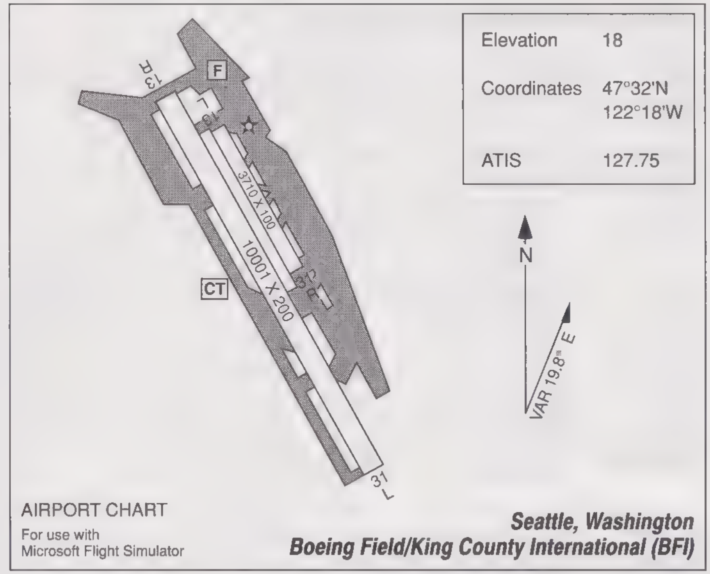
Seattle Sectional Airport Directory

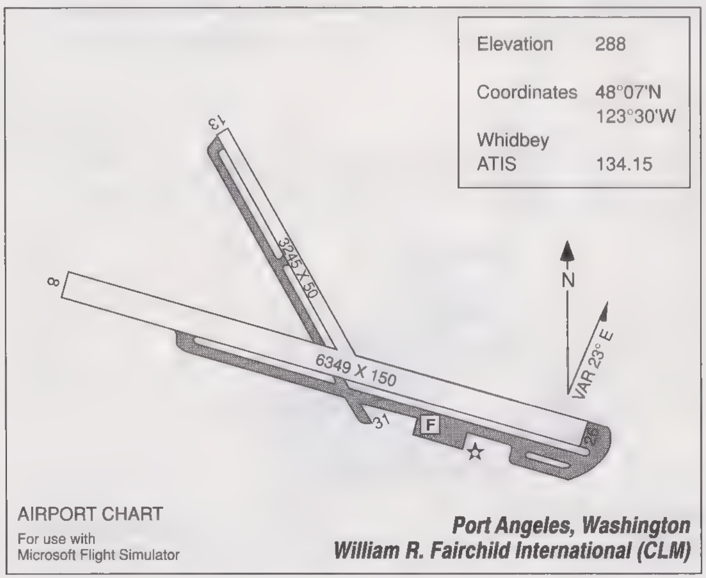
City	Airport	North	West	Elev.	Fuel	ILS
Alderwood Manor	Martha Lake	47°52'	122°14'	500		
Arlington	Arlington Municipal	48°10'	122°09'	137		
Auburn	Auburn Municipal	47°20'	122°14'	57		
Bremerton	Bremerton National	47°30'	122°46'	439		
Everett	Everett/Snohomish Co. (Paine Fld)	47°54'	122°17'	606	*	16/109.3
Monroe	First Air Field	47°52'	122°00'	50		
Olympia	Olympia	46°58'	122°54'	206	*	
Puyallup	Pierce Co.-Thun Fld.	47°06'	122°17'	530		
Port Angeles	William R. Fairchild Intl.	48°07'	123°30'	288	*	
Port Orchard	Port Orchard	47°27'	122°40'	370		
Renton	Renton Municipal	47°30'	122°13'	29		
Seattle	Seattle/Boeing Fld./King Co. Intl.	47°32'	122°18'	18	*	
Seattle	Seattle-Tacoma Intl.	47°27'	122°18'	429	*	
Shelton	Shelton/ Sanderson Fld.	47°14'	123°09'	278		
Snohomish	Harvey Fld.	47°54'	122°06'	16		
Spanaway	Shady Acres	47°04'	122°22'	445		
Spanaway	Spanaway	47°05'	122°26'	373		
Tacoma	Tacoma Narrows	47°16'	122°35'	292		

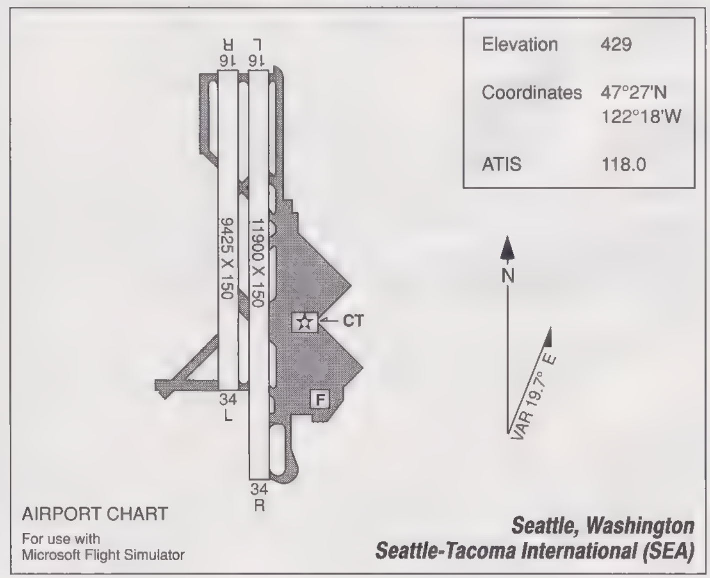
Latitude and longitude coordinates will take you to the airport of your choice but will not necessarily place you on a runway.




Elevation 206
Coordinates 46°58'N 122°54'W
CT 124.4
17
CT
F
8
5419 X 150
5001 X 150
26
N
VAR 22' E
35
AIRPORT CHART
For use with
Microsoft Flight Simulator
Olympia, Washington
Olympia (OLM)


Elevation 18
Coordinates 47°32'N 122°18'W
ATIS 127.75
13 R
F
13 L
3710 X 100
10001 X 200
CT
31 R
31 L
N
VAR 19.8° E
AIRPORT CHART
For use with
Microsoft Flight Simulator
Seattle, Washington
Boeing Field/King County International (BFI)


Elevation 288
Coordinates 48°07'N 123°30'W
Whidbey ATIS 134.15
13
8
3245 X 50
6349 X 150
31
F
26
N
VAR 23° E
AIRPORT CHART
For use with
Microsoft Flight Simulator
Port Angeles, Washington
William R. Fairchild International (CLM)


Elevation 429
Coordinates 47°27'N 122°18'W
ATIS 118.0
16 R
16 L
9425 X 150
11900 X 150
CT
F
34 L
34 R
N
VAR 19.7° E
AIRPORT CHART
For use with
Microsoft Flight Simulator
Seattle, Washington
Seattle-Tacoma International (SEA)

Appendix C Performance Specifications

This appendix lists important information about the engines, accommodations, dimensions, and performance of the Cessna, Learjet, Sailplane, and Sopwith Camel.

Cessna Skylane RG

You can also review the performance specifications for all Flight Simulator aircraft by choosing Aircraft from the Options menu, and then choosing the Performance Specs button.

Introduced in late 1977, the retractable landing gear version of the Skylane is called the Skylane RG.

Engine	Avco Lycoming O-540-J3C5D flat six
Seats	4
Length	28 ft 7.5 in (8.72 m)
Height	8 ft 11 in (2.72 m)
Wingspan	35 ft 10 in (10.92 m)
Wing area	174 sq ft (16.16 m^2)
Max ramp weight	3112 lb (1412 kg)
Max takeoff and landing weight	3100 lb (1406 kg)
Standard empty weight	1784 lb (809 kg)
Max useful load	1328 lb (602 kg)
Wing loading	17.8 lb/sq ft (89.6 kg/m^2)
Power loading	13.2 lb/hp (8.03 kg/kW)
Max usable fuel	88 gal (333 liters, 73.3 Imp gal)
Max rate of climb at sea level	1140 ft (347 m) /min
Max rate of climb at 8000 ft (2438 m)	455 ft (138.7 m) /min
Service ceiling	14,300 ft (4359 m)
Max operating speed	160 knots (184 mph, 296 km/h)
Cruise, 75% power at 7500 ft (2286 m)	156 knots (179 mph, 289 km/h)
Stall speed clean	54 knots (62 mph, 100 km/h)
Stall speed flaps/gear down	50 knots (58 mph, 93 km/h)
Landing gear	Retractable tricycle, steerable nosewheel

Learjet 35A

You can also review the performance specifications for all Flight Simulator aircraft by choosing Aircraft from the Options menu, and then choosing the Performance Specs button.

Although generally similar in basic configuration to the Learjet 25, the Learjet 35A is slightly larger in size and is powered by turbofan engines. This light business jet was awarded FAA certification in July 1974.

Engines	Garrett TFE731-2-2B turbofans, 3500 lb st (15.6 kN) each
Passengers	8
Length	48 ft 8 in (14.83 m)
Height	12 ft 3 in (3.73 m)
Wingspan	39 ft 6 in (12.04 m)
Wing area	253.3 sq ft (23.53 m^2)
Aspect ratio	5.7
Max ramp weight	18,500 lb (8391 kg)
Max takeoff weight	18,300 lb (8300 kg)
Standard empty weight	9838 lb (4462 kg)
Max landing weight	15,300 lb (6940 kg)
Wing loading	71.1 lb/sq ft (347.1 kg/m^2)
Power loading	2.57 lb/lb st (261.7 kg/kN)
Service ceiling	45,000 ft (13,716 m)
Max usable fuel	925 US gal (3501 liters, 771 Imp gal)
Hydraulic system max flow rate	4 US gal (15 liters, 3.33 Imp gal) /min
Max pressurization differential	9.4 lb (0.65 bar) /sq in
Max operating speed	0.81 Mach
Econ cruise at 45,000 ft (13,716 m)	418 knots (481 mph, 774 km/h)
Max cruise speed at 41,000 ft (12,497 m)	460 knots (529 mph, 852 km/h)
Max rate of climb at sea level	4340 ft (1323 m) /min
Landing approach speed	128 knots (147 mph, 237 km/h)
Stall speed flaps/gear down	96 knots (110 mph, 178 km/h)
Landing gear	Retractable tricycle, steerable nosewheel

Schweizer 2-32 Sailplane

You can also review the performance specifications for all Flight Simulator aircraft by choosing Aircraft from the Options menu, and then choosing the Performance Specs button.

The prototype for the two-seater Schweizer 2-32 was built in 1962. At that time, it represented the ultimate in sailplane perfection and was type certificated for both high performance and utility categories. We list the high-performance specifications below.

Length	26 ft 9 in (8.15 m)
Wingspan	57 ft (17.37 m)
Height	9 ft (2.74 m)
Wing area	180 sq ft (16.72 m^2)
Aspect ratio	18.05
Gross weight	1340 lb (608 kg)
Standard empty weight	831 lb (377 kg)
Max useful load	490 lb (222 kg)
Wing loading	7.44 lb/sq ft (34.6 kg/m^2)
Max operating speed	150 knots (173 mph, 278 km/h)
Stall speed (solo)	48 knots (55 mph, 89 km/h)
Max L/D	34 ft at 59 mph (10 m at 95 km/h)
Min sink (solo)	2.1 ft at 58 mph (.64 m at 93 km/h)/sec
Landing gear	Non-retractable wheel under fuselage

Sopwith Camel

You can also review the performance specifications for all Flight Simulator aircraft by choosing Aircraft from the Options menu, and then choosing the Performance Specs button.

The British Sopwith Aviation Company, Ltd., designed the single-seater Sopwith Fighting Biplane, known as the "Camel." It was simple and reasonably inexpensive to build, and was manufactured in considerable numbers for the British and United States military. Sopwith Camels were among the most successful 1917 fighting machines.

Engine	Clerget
Length	18 ft 9 in (5.72 m)
Height	9 ft (2.74 m)
Wingspan	28 ft (8.53 m)
Gross weight	1482 lb (672 kg)
Standard empty weight	950 lb (431 kg)
Effective ceiling	19,000 ft (5791 m)
Max operating speed at 10,000 ft (3048 m)	98 knots (112.7 mph, 181 km/h)
Max operating speed at 15,000 ft (4572 m)	92 knots (106 mph, 170 km/h)
Stall speed	50 knots (58 mph, 93 km/h)
Landing gear	Taildragger

Appendix D Keyboard Summary

This appendix summarizes all the keyboard controls for Microsoft Flight Simulator 5.0. The F keys are located across the top of some keyboards, while on others the F keys are located on the left side. These differences are noted.

Following are keyboard conventions used in this book.

When you read this	Do this
SHIFT+PLUS SIGN	Hold down the SHIFT key and press the character or letter beside it (in this case the PLUS SIGN).
KEYPAD 8	Press 8 on the numeric keypad.
A, B	Press the A key followed by the B key.
TT	Press the T key twice in rapid succession.

Displaying Menus and the Menu Bar

You can quickly close any open menus and dialog boxes and resume flying, or turn the menu bar on and off if you only want to see scenery from your cockpit.

To close open menus

▶ Press SPACEBAR.

To turn the menu bar on or off

▶ Press ESC.

Saving and Resetting a Situation

You can save a situation or restart it from the beginning at any time while you are flying.

To save a situation

▶ Press SEMICOLON (;).

To reset a situation

▶ Press CTRL+PRINT SCREEN.

Quitting Flight Simulator

You can quit Flight Simulator quickly and easily at any time.

To quit Flight Simulator

- Press CTRL+C, and then choose the OK button.
  –or–
  Press CTRL+BREAK to go to the MS-DOS prompt immediately.

Controlling Windows

You can switch windows with the keyboard by pressing the following keys.

To choose	Press
View 1	[
View 2	]
Map View	NUMLOCK

When you press any of these keys twice in rapid succession, Flight Simulator no longer displays the view window. For example, when you press NUMLOCK once, Flight Simulator displays the map window. When you press NUMLOCK twice, Flight Simulator turns off the map.

When you have two or three windows displayed and they overlap, press the key for the window you want on top and then press the APOSTROPHE key. For example, if you have all three windows open and you want the map window to be displayed on top, press NUMLOCK, and then press APOSTROPHE.

If you press the zoom keys and nothing happens, make sure you have selected the view window. Press the OPENING BRACKET ([) key for View 1, the CLOSING BRACKET (]) key for View 2, or the NUMLOCK key for Map View.

You can change the magnification of a window by pressing the following keys.

To zoom	Press
In	PLUS SIGN
In (fine)	SHIFT+PLUS SIGN
Out	MINUS SIGN
Out (fine)	SHIFT+MINUS SIGN
1X (normal magnification)	BACKSPACE

You can also maximize View 1, View 2, or Map View with one keystroke.

To maximize a window

Press the w key again to return the window to its previous size.

- Choose the window you want, and then press W.

Controlling Views

For more information on changing your view direction, see "View Controls" on page 66.

In Cockpit and Spot views, you can look in nine directions. You cannot change the view direction in Tower or Track views.

Press the following keys to choose a view direction while in Cockpit or Spot view.

View direction	Key
Front	SHIFT+KEYPAD 8
Rear	SHIFT+KEYPAD 2
Left	SHIFT+KEYPAD 4
Right	SHIFT+KEYPAD 6
Left front	SHIFT+KEYPAD 7
Right front	SHIFT+KEYPAD 9
Left rear	SHIFT+KEYPAD 1
Right rear	SHIFT+KEYPAD 3
Down	SHIFT+KEYPAD 5
Pan up	SHIFT+BACKSPACE
Pan down	SHIFT+ENTER
Straight and level (no pan)	SCROLL LOCK or KEYPAD ASTERISK followed by KEYPAD 8

You can cycle through the different view perspectives at any time with the following key.

To cycle through Cockpit, Tower, and Spot views

Flight Simulator also displays Track view in Dual-Player flight.

- Press S (or SHIFT+S for reverse order).

Using the Video Recorder

Here are some quick keys to use while you are recording videos with the Video Recorder command on the Options menu.

To	Press
Stop recording a video	BACKSLASH (\)
Record at a 1-second interval	6
Record at a 5-second interval	7
Insert messages during playback	COMMA (,)
Stop playback	ESC

Stopping Instant Replay

After you choose Instant Replay from the Options menu, you can stop it at any time.

To stop Instant Replay

▶ Press ESC.

Stopping Maneuver Analysis

When you choose Flight Analysis from the Options menu, Flight Simulator analyzes your maneuvers or landings. You can stop Maneuver Analysis quickly and easily at any time and see a Maneuver Analysis graph.

To stop Maneuver Analysis

▶ Press BACKSLASH (\).

Choosing Instruments and Instrument Panels

You can choose different instruments and switch between different sections of an instrument panel with the keyboard.

To choose different instruments

▶ Press SHIFT+TAB.

On the Cessna, pressing SHIFT+TAB lets you choose either the VOR 2 or the ADF gauge. On the Learjet, pressing SHIFT+TAB lets you choose VOR 1, VOR 2, or the ADF gauge.

To switch between different sections of an instrument panel

- Press TAB.

The instrument panels for some of the Flight Simulator aircraft have subsections. Pressing the TAB key lets you switch between these subsections quickly and easily.

Using Aircraft Controls

You can turn aircraft controls on and off and adjust instruments using the following keys.

Control	Key
Land Me	X
Landing gear up/down	G
Brakes	PERIOD
Differential brakes	F11 (left) or F12 (right)
Parking brakes	CTRL+PERIOD (to apply), PERIOD (to release)
Carb heat on/off	H
Magnetos on/off	M, and then PLUS SIGN or MINUS SIGN
Jet starter switches on/off	J+1 or J+2, and then PLUS SIGN or MINUS SIGN
Jet engine shut down	CTRL+SHIFT+F1
Jet engine restart fuel flow	CTRL+SHIFT+F4
Engine and control selectors	E+1 for engine 1, E+2 for engine 2, E+1+2 for both engines
All lights on/off	L
Instrument lights on/off	SHIFT+L
Landing light on/off	CTRL+L
Strobes on/off	O
Smoke/spray on/off	I
Autopilot on/off	Z
Sound on/off	Q

Control	Key
Pause/resume flight	P
Spoilers on/off (Learjet and Sailplane)	SLASH (/)
Rate of simulation	R, and then PLUS SIGN or MINUS SIGN
Formation flying catch-up	SPACEBAR

Using Flight Controls

You can fly the Cessna, the Learjet, the Sailplane, or the Sopwith Camel using the following keyboard controls.

Control	Key (F keys on top)	Key (F keys on left side)
Ailerons		
Left	KEYPAD 4	KEYPAD 4
Center	KEYPAD 5	KEYPAD 5
Right	KEYPAD 6	KEYPAD 6
Elevator		
Nose up	KEYPAD 2	KEYPAD 2
Nose down	KEYPAD 8	KEYPAD 8
Elevator trim		
Nose up	KEYPAD 1	KEYPAD 1
Nose down	KEYPAD 7	KEYPAD 7
Rudder		
Left	KEYPAD 0	KEYPAD 0
Center	KEYPAD 5	KEYPAD 5
Right	KEYPAD ENTER*	KEYPAD ENTER*
Flaps		
Fully retracted (0°)	F5	F1
10°	F6	F3
20°		F5
30°	F7	F7
Fully extended (40°)	F8	F9

Control	Key (F keys on top)	Key (F keys on left side)
Throttle		
Increase slowly	KEYPAD 9	KEYPAD 9
Decrease slowly	KEYPAD 3	KEYPAD 3
Cut	F1	F10
Decrease slowly	F2	F8
Increase slowly	F3	F6
Full	F4	F4
Propeller Control		
Increase	CTRL+KEYPAD 9	CTRL+KEYPAD 9
Decrease	CTRL+KEYPAD 3	CTRL+KEYPAD 3
Cut	CTRL+F1	CTRL+F10
Decrease/less	CTRL+F2	CTRL+F8
Increase/more	CTRL+F3	CTRL+F6
Full	CTRL+F4	CTRL+F2
Mixture Control		
Increase	CTRL+SHIFT+KEYPAD 9	CTRL+SHIFT+KEYPAD 9
Decrease	CTRL+SHIFT+KEYPAD 3	CTRL+SHIFT+KEYPAD 3
Cut	CTRL+SHIFT+F1	CTRL+SHIFT+F10
Decrease/less	CTRL+SHIFT+F2	CTRL+SHIFT+F8
Increase/more	CTRL+SHIFT+F3	CTRL+SHIFT+F6
Full	CTRL+SHIFT+F4	CTRL+SHIFT+F2
EGT bug needle		
Move needle forward	U+PLUS SIGN	U+PLUS SIGN
Move needle back	U+MINUS SIGN	U+MINUS SIGN

* On some keypads, the bottom-right key is the PLUS SIGN and on others it is ENTER. Ignore the keycap legend and use the bottom-right key.

To see a readout of your coordinates (altitude, latitude, longitude) while you fly

- Press SHIFT+Z.

Calibrating Instruments

You can calibrate the altimeter and directional gyro, or heading indicator, using the following keys.

Instrument	Key
Altimeter (barometric pressure)	B
Directional gyro	D
Joystick	K

Setting Radios

You can set Flight Simulator's radio frequencies using the following keys.

Radio	Keys
ADF	A (first digit), AA (second digit), AAA (third digit), followed by PLUS SIGN or MINUS SIGN (activate the ADF gauge on the Nav/Com menu first)
COM	C followed by PLUS SIGN or MINUS SIGN; CC followed by PLUS SIGN or MINUS SIGN for fractional frequency
NAV	N+1 or N+2 followed by PLUS SIGN or MINUS SIGN; NN followed by PLUS SIGN or MINUS SIGN for fractional frequency
Transponder	T (first digit), TT (second digit), TTT (third digit), or TTTT (fourth digit), followed by PLUS SIGN or MINUS SIGN
VOR OBI	V+1 or V+2 followed by PLUS SIGN or MINUS SIGN (SHIFT+PLUS SIGN and SHIFT+MINUS SIGN adjust in 10-degree increments)
DME	F+1 or F+2 for DME 1 or DME 2. PLUS SIGN for readout of speed toward station in knots (KTS) or distance in nautical miles (NM)

Slewing

With slewing you can change position or location quickly. To use any of the slewing keys and turn on the slew location digits, you must first choose the Slew command from the World menu, or press the Y key.

To turn the location digits on or off

- Press Z.

Slew control	Key (F keys on top)	Keys (F keys on left side)
Altitude		
Up slowly	Q (multiple keystrokes)	Q (multiple keystrokes)
Up fast	F4	F2
Freeze	F2 or F3	F6
Down fast	F1	F10
Down slowly	A (multiple keystrokes)	A (multiple keystrokes)
Pitch		
Nose up slowly	9 (multiple keystrokes)	9 (multiple keystrokes)
Nose up fast	F5	F1
Freeze	F6 or F7	F5
Nose down fast	F8	F9
Nose down slowly	0 (multiple keystrokes)	F7
Bank		
Left	KEYPAD 7	KEYPAD 7
Right	KEYPAD 9	KEYPAD 9
Freeze	KEYPAD 5	KEYPAD 5
Heading		
Left	KEYPAD 1	KEYPAD 1
Right	KEYPAD 3	KEYPAD 3
Freeze	KEYPAD 5	KEYPAD 5
Movement		
Forward	KEYPAD 8	KEYPAD 8
Backward	KEYPAD 2	KEYPAD 2
Right	KEYPAD 6	KEYPAD 6
Left	KEYPAD 4	KEYPAD 4
Freeze	KEYPAD 5	KEYPAD 5

After slewing, you can easily reset your aircraft orientation to straight-ahead pitch, north heading, 0-degree bank.

To reset orientation

▶ Press SPACEBAR.

Appendix E Accessibility for People with Disabilities

Microsoft is committed to making its products and services easier for everyone to use. This appendix provides information about the following products and services, which make Microsoft products more accessible for people with disabilities:

- Microsoft support services for people who are deaf or hard-of-hearing
- Microsoft software documentation on audio cassettes and floppy disks
- Products available for people who are blind or have low vision
- Information about other products and services for people with disabilities

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Important The information in this section applies only to Flight Simulator users in the United States. If you are outside the United States, your Flight Simulator package contains a subsidiary information card listing product-support telephone numbers and addresses. You can contact your subsidiary to find out whether the type of products and services described here are available in your area.

Microsoft Support Services for People Who Are Deaf or Hard-of-Hearing

Through a text telephone (TT or TDD) service, Microsoft provides people who are deaf or hard-of-hearing with complete access to Microsoft's product and customer support services.

You can contact Microsoft support services using a text telephone by dialing (206) 635-4948 between 6:00 A.M. and 6:00 P.M. Pacific time. Microsoft's product-support services are subject to Microsoft's prices, terms, and conditions in place at the time the service is used.

Documentation on Audio Cassettes and Floppy Disks

People who cannot use printed documentation can obtain most of Microsoft's publications from Recording for the Blind, Inc. Recording for the Blind distributes these documents on audio cassettes or floppy disks to registered members of their distribution service. Recording for the Blind's collection contains more than 80,000 titles, including Microsoft product documentation and books from Microsoft Press. You can contact Recording for the Blind at the following address:

Recording for the Blind, Inc.
20 Roszel Road
Princeton, NJ 08540

Phone: (800) 221-4792
Fax: (609) 987-8116

From outside the United States, you can contact Recording for the Blind at: (609) 452-0606

Products for People Who Are Blind or Have Low Vision

There are numerous products available to help people who are blind or have low vision. For people with low vision, there are several screen-enlargement utilities, and for people who cannot use visual information there are screen readers that provide alternative output by synthesized voice or refreshable Braille displays.

For more information on the various products available, see the next topic, "Getting More Information."

Getting More Information

For more information on Microsoft products and services for people with disabilities, contact Microsoft Customer Sales and Service at (800) 426-9400 (voice) or (206) 635-4948 (text telephone).

The Trace R&D Center at the University of Wisconsin—Madison produces a book and a compact disc that describe products that help people with disabilities use computers. The book, titled *Trace ResourceBook,* provides descriptions and photographs of about 2000 products. The compact disc, titled *CO-NET CD,* provides a database of more than 17,000 products and other information for people with disabilities. It is issued twice a year and should be available in many public libraries by early 1993.

You can contact the Trace R&D Center by using the following address or telephone numbers:

Trace R&D Center
S-151 Waisman Center
1500 Highland Avenue
Madison, WI 53705-2280

Voice telephone: (608) 263-2309
Text telephone: (608) 263-5408
Fax: (608) 262-8838

For general information and recommendations on how computers can help specific people, you should consult a trained evaluator who can best match the individual's needs with the available solutions.

If you are in the United States, you can obtain information about resources in your area by calling the National Information System, an information and referral center for people with disabilities, at the following address:

National Information System (NIS)
Center for Developmental Disabilities
University of South Carolina, Benson Bldg.
Columbia, SC 29208

Phone: (800) 922-9234 (voice/text telephone outside South Carolina)
(800) 922-1107 (voice/text telephone in South Carolina)
(803) 777-6222 (voice/text telephone outside the United States)

Fax: (800) 777-6058

This service is available only in the English languge.

Glossary

Terms printed in italic in the Glossary are defined elsewhere in the Glossary.

A

Accelerated maneuver stall A *stall* hastened by excessive maneuvering loads, imposed by turns, pullups, or other abrupt flight-path changes.

Active runway The runway used for takeoffs and landings. Most large airports have more than one runway. They usually cross each other so that the airport can handle takeoffs and landings under varying wind conditions. For safety reasons it is impractical to have takeoffs and landings from more than one runway at a time. The runway in use is called the active runway.

Ailerons The adjustable surfaces on the outside trailing edges of the wings that control *bank.*

Air traffic control (ATC) The ground-based radio network consisting of ground (controls taxiing to and from the *active runway*), tower (controls the runway itself, giving permission to land and take off), departure (controls aircraft departing from a specific airfield), center (controls the *airspace* at higher altitudes), and approach (controls those aircraft arriving into the airspace immediately surrounding the airfield).

Airfoil A general term describing a surface or body, such as a wing or propeller blade, designed to obtain a reaction, such as lift or thrust, from the air through which it moves. Engineers use the term to describe the special shape that produces lift.

Airspace Roughly, the air around a given area. For example, the air around the United States is called the "United States' airspace."

Airspeed indicator The indicator that displays an aircraft's present airspeed. See also *ground speed, indicated airspeed,* and *true airspeed.*

Altimeter The indicator that displays an aircraft's present altitude. It is usually calibrated to give mean sea level (MSL) altitude. Most altimeters are called pressure altimeters because they measure the decrease in *atmospheric pressure* as the aircraft climbs. Because of this, the altimeter must be calibrated to the local atmospheric pressure to compensate for regional variations in pressure that would make the readings inaccurate.

Angle of attack The angle between the wing's *chord line* and the *relative wind.*

Approach attitude The aircraft's *longitudinal axis* angle with respect to the horizon when making a landing approach.

Approach lighting system (ALS) Complex airport lighting system that helps *instrument flight rule (IFR)* pilots make the transition to visual references at the end of an instrument approach. An ALS can also aid *visual flight rule (VFR)* pilots operating at night. These aids are usually color-coded or sequenced flashing lights that clearly define the runway and touchdown zone.

Artificial horizon See *attitude indicator.*

Aspect ratio Ratio between the wingspan and the average *chord* of the wings.

Attitude indicator The instrument that shows the aircraft's *pitch* and *bank* attitudes with respect to the ground. This instrument is used to provide attitude references when the true horizon cannot be seen, as when flying into a cloud. Also called artificial horizon.

Automatic direction finder (ADF) A general navigation instrument used with *nondirectional radio beacons* (NDBs) or commercial AM radio stations to determine relative bearing.

Automatic terminal information service (ATIS) A continuous-loop recording, usually updated once an hour, played over a specified frequency. ATIS gives weather and other important information for an airfield.

Atmospheric pressure The pressure exerted by the air on the earth and everything on it. This is measured in inches (or millibars) of mercury on an instrument called a barometer. Thus, the term *barometric pressure* is frequently interchanged with atmospheric pressure. Typically, the pressure is between 28 and 32 inches of mercury at sea level, decreasing at higher elevations.

Attitude flying Flying based on an aircraft's attitude, or orientation to the world around it.

Auto coordination The term used to describe the connection between the *rudder* and *ailerons* that automatically moves one as the pilot moves the other, resulting in properly coordinated turns with no *skids* or *slips*.

Autopilot A navigation aid that pilots can use to fly a desired altitude and heading or *very high-frequency omnidirectional range (VOR)* station so that they can devote more time to other flight tasks.

Axis indicator In Flight Simulator, this indicator shows the current axis of the aircraft and gives a good indication of where the aircraft's center is pointing. You can turn the axis indicator on and off or change its shape by choosing View Options from the Views menu, and then choosing the Axis Indicator option.

B

Balloon To increase the pitch attitude and *angle of attack* too rapidly. Ballooning can be dangerous, as it can create a *stall.*

Bank Those actions taking place about an aircraft's *longitudinal axis*. Also called roll.

Barometric pressure See *atmospheric pressure.*

Bleed off To slowly decrease a given parameter, such as airspeed or altitude, in a carefully controlled manner.

C

Canard configuration A canard is a small forward wing, as well as a stabilizer, that is located in front of the main wings. Canards were used in the pioneering days of aviation and are now reappearing on several original designs. Since a canard configuration utilizes the concept of two lifting surfaces—both the main wings and the canard—it is aerodynamically efficient.

Canted gyroscope A gyroscope within a flight instrument, usually the turn coordinator, with a rotational axis that is tilted or canted with the aircraft's *longitudinal axis*. The tilted axis causes the gyro to respond to a *banking* or *yawing* motion.

Ceiling The altitude of the lowest broken or overcast cloud layer.

Centrifugal force The force that tends to impel an object outward from the center of rotation.

Chord A cross-section of the wing taken from the leading edge to the trailing edge. Usually refers to the cross-section taken at the wingtip.

Chord line An imaginary line extending from the center of the leading edge to the center of the trailing edge of an aircraft's wing.

COM Short for communication. Usually refers to the communication radio.

Control yoke The control device and connections that adjust the *ailerons* and *elevator*. The ailerons are controlled by turning the control yoke like a steering wheel, and the elevator is controlled by moving the yoke toward or away from you. Some airplanes have a joystick in place of a control yoke.

Coordinated flight See *auto coordination.*

Course deviation indicator (CDI) A vertical needle on the *omni-bearing indicator (OBI)* that shows your deviation from the *very high-frequency omnidirectional range (VOR)* radial set by the *course selector*. If the needle is to the right of center, the radial lies to the right of your current position.

Course selector A numeric value that appears at the top of the *omni-bearing indicator (OBI)*. This number indicates the radial to which your OBI receiver is set.

Crab angle The difference between an aircraft's heading and the aircraft's ground track. This is determined by the crosswind component and the airspeed of the aircraft; the stronger the crosswind and the lower the airspeed, the larger the aircraft's crab angle will be.

Cruise speed The average speed of an aircraft during straight and level flight.

D

Dead reckoning The navigation of an airplane solely by computations based on airspeed, course, heading, wind direction and speed, ground speed, and elapsed time.

Decision height The altitude at which, during a landing approach, a pilot must decide whether to land or retry the landing attempt.

Density altitude The altitude where the density of the air at the current altitude is normally found. Air is usually less dense at higher altitudes. However, certain conditions affect air density: increase in temperature and decrease in atmospheric pressure both cause air density to decrease. If an aircraft is flying at 1000 feet above sea level and the air temperature is higher than normal, the air at that altitude may have the density of air normally found at 2000 feet. In this case, the density altitude would be 2000 feet.

Design maneuvering speed See *maneuvering speed.*

Dihedral The angle (if any) at which an aircraft's wings tilt upward from the fuselage, forming a slight "V" shape as you look at the aircraft head-on. Dihedral increases stability and tends to level an aircraft automatically after a turn.

Directional gyro See *heading indicator*.

Distance measuring equipment (DME) A radio that determines and displays distance from a *very high-frequency omnidirectional range (VOR)* in nautical miles.

Drag The retarding force acting on an aircraft moving through the air, parallel and opposite to the direction of motion.

Drift The lateral motion of an aircraft due to air currents.

E

Electronic flight instrument systems (EFIS) Advanced navigational aids that cover a range of applications and options in modern aircraft, from engine controls and checklists on CRT displays to advanced equipment that projects symbology and instrumentation on the pilot's windshield.

Elevator trim See *trim.*

Elevator The adjustable surface on the trailing edge of the *horizontal stabilizer* that controls an aircraft's *pitch*. When the elevator is down (the *control yoke* is pushed forward), the stabilizer is pushed up by the air. This forces the nose down and causes the aircraft to dive. The opposite is true for climbs.

Empennage The tail of an aircraft.

F

Federal Aviation Administration (FAA) This agency, under the direction of the Department of Transportation, is responsible for maintaining safe and efficient use of the nation's *airspace* by military and civil aviators, for fostering civil aeronautics and air commerce in the United States and abroad, and for supporting the requirements of national defense.

Fixed base operator (FBO) At an airport, a person or an organization that sells fuel, sells or rents aircraft, and possibly gives flight instruction.

Flaps Movable *airfoil* sections, located on the trailing edge of the wings, that are lowered on takeoff and landing to increase the wings' *lift* and *drag*.

Flare To level off a foot or two above the runway prior to landing by raising the nose of the aircraft just before touchdown. This is the last segment of a landing approach. Also called roundout.

Fuselage The body of an aircraft.

G

G force A unit of force equal to the force exerted by gravity on a body at rest. Used to indicate the force an aircraft is subjected to when accelerating or maneuvering.

Glide slope A type of *very high-frequency omnidirectional range (VOR)* transmitter used in an *instrument landing system (ILS)* approach to provide vertical guidance to an aircraft as it descends to the runway.

Ground effect A usually beneficial influence on aircraft performance that occurs while you are flying close to the ground.

Ground loop A sudden, accidental turn at touchdown that whips an aircraft off the runway. It happens when the aircraft's wheels are not straight at ground contact.

Ground speed An aircraft's speed relative to the ground. For example, if an aircraft is flying level at 120 knots *true airspeed* and has a 15-knot head wind, its ground speed is 105 knots.

Gyroscopic precession Occurs when a force is applied to any point on the rim of the propeller's plane of rotation. The resultant force is 90 degrees from the point of application in the direction of rotation. Depending on where the force is applied, the aircraft will *yaw* left or right, *pitch* up or down, or experience a combination of pitching and yawing. To correct for the effect of gyroscopic precession, the pilot must properly use elevator and rudder to prevent undesired pitching and yawing.

H

Heading The direction in which an aircraft is pointed. This is not necessarily the direction in which the aircraft is traveling. It is usually referred to as a magnetic heading, but the word "degrees" is omitted by most experienced pilots ("My heading is 324.").

Heading indicator A gyroscopically controlled compass that is designed to give *heading* information based on the forces acting on a gyroscope, rather than an actual magnetic reading. It is used to provide a more accurate readout of heading without having to deal with magnetic compass lag and settling time after a turn, descent, acceleration, or deceleration climb.

Hood A device worn by pilots who are learning to fly by instruments. The hood covers the upper portion of the pilot's field of vision so that he or she must rely solely on the instruments.

Horizontal stabilizer The surface that is used to provide stabilization along the aircraft's *lateral axis* to control *pitch.* Usually thought of as part of the airplane's tail, or *empennage*.

I

Inclinometer An instrument that displays the inclination to the horizontal of an axis. In most aircraft, there is an inclinometer at the bottom of the *turn coordinator.* It indicates when the aircraft is *yawing* to the left or right.

Indicated airspeed The speed of an aircraft as shown on the *airspeed indicator.*

Induced drag The drag that results from lift being produced. The *relative wind* is deflected downward by the wing, giving a rearward component to the lift vector called induced drag.

Initial climb An aircraft's climb away from the runway, after *liftoff.*

Instrument flight rules (IFR) The "rules of the road" that cover flight in *instrument meteorological conditions (IMC)* and high altitudes.

Instrument landing system (ILS) A system of radio transmitters and receivers, approach lights, and special flight rules that provide a three-dimensional, in-the-cockpit reference for landing. The transmitters consist of a *localizer,* a *glide slope,* and outer, middle, and inner *marker beacons.* The localizer transmits a single, very directional signal that leads an aircraft to a specific runway at an airport. The glide slope does the same thing in the vertical plane, leading the aircraft down to the runway at the correct approach attitude. The marker beacons indicate distance from the runway. An aircraft with ILS capabilities registers these transmissions using the glide-slope needle and the localizer needle on the *omni-bearing indicator.*

Instrument meteorological conditions (IMC) Weather conditions that force flight under *instrument flight rules (IFR).*

Instrument rating The rating for a pilot who has finished *instrument flight rule (IFR)* training and passed the exam.

Isogonic line A line on a map connecting points of equal *magnetic declination.*

K

Knots Nautical miles per hour. A nautical mile is defined as 1 minute of longitude at the equator, or 1.15 statute miles. To convert from knots to statute miles per hour, multiply knots by 1.1507; to convert the other way, multiply statute miles per hour by .869.

L

Landing gear The wheels, struts, and other equipment that an aircraft uses to land or maneuver on the ground. The two most common types of landing gear are "taildragger," in which the front of the aircraft is supported on two wheels while the tail rests on the ground on a skid or a tail wheel, and "tricycle," in which the aircraft sits level with the ground on one nosewheel and two wheels farther back on the aircraft. The main landing gear are those nearest the aircraft's center of gravity. Main landing gear almost always come in pairs (left and right main gear), and are designed to withstand a greater landing shock than the more fragile nosewheel or tail wheel.

Lateral axis An imaginary axis running from wingtip to wingtip.

Lift The upward force on an aircraft.

Liftoff The moment at which an aircraft leaves the ground during takeoff.

Localizer A highly sensitive *very high-frequency omnidirectional range (VOR)* station used on only one radial lined up with the runway. The localizer helps the pilot to hold a precise horizontal course.

Longitudinal axis An imaginary axis running from front to rear through an aircraft's center of gravity approximately parallel to the thrust line (the propeller's axis).

M

Mach A usually high speed expressed by a Mach number. For example, Mach 1 is the speed of sound or 1116 feet per second.

Magnetic compass A device for determining direction by use of a magnetic needle.

Magnetic declination The angle of variation between "true north" and "magnetic north." This varies from one location to another and must be considered when navigating long range.

Magneto A device that combines the functions of an automobile engine's coil and distributor. It takes energy from the aircraft engine in the form of rotational energy and, by use of magnetics and induced electricity, creates the high voltages required to fire the spark plugs.

Maneuvering speed The maximum speed at which you can use full, abrupt control movement without creating excessive *G force* that could damage an aircraft's structure. It is also the maximum speed at which you can safely *stall* an aircraft.

Manifold pressure gauge An instrument that measures the air or fuel and air pressure in the intake manifold in inches of mercury. This instrument is used in combination with the *tachometer* to set up the desired power from the engine.

Manually coordinated flight See *uncoordinated flight*.

Marker beacons Beacons placed on the ground directly below the *localizer* path at preset intervals to give aircraft that fly over them information about the distance to the runway.

Mixture control An instrument for controlling the ratio of fuel-to-air mixture of an aircraft. A mixture that is too rich contains too much fuel for the existing conditions, and a mixture that is too lean does not contain enough fuel.

Mmo The abbreviation for *Mach* maximum operating speed.

N

Nautical miles See *knots*.

NAV Short for navigational. Usually refers to the navigational radio.

NavCom A radio that combines the functions of a communication radio with those of a navigational radio.

Navigation lights The anti-collision light system required by the *Federal Aviation Administration (FAA)* on all aircraft in flight. The system includes a red light on the left wingtip, a green light on the right wingtip, and a red rotating beacon light on the tail. These lights tell other aircraft which direction an aircraft is flying when only the lights can be seen.

Nondirectional radio beacon (NDB) A radio beacon transmitting nondirectional signals whereby the pilot of an aircraft equipped with an *automatic direction finder (ADF)* can determine his or her bearing to or from the radio beacon and track to or from the station.

Nose over To pitch forward.

O

Omni-bearing indicator (OBI) The indicator that displays information about an aircraft's position relative to the tuned *very high-frequency omnidirectional range (VOR)* station. The OBI usually provides the ability to "dial in," or select a given course or radial, and includes a TO-FROM indicator and a *course deviation indicator (CDI)*. On aircraft with *instrument landing system (ILS)* capabilities, a *glide-slope* needle is also included in the OBI. There is no official name for this instrument. It is sometimes referred to as the omni-bearing selector (OBS) or VOR receiver and indicator.

P

Parasite drag The drag composed of form drag (drag due to the landing gear, radio antennas, shape of the wings, and so on), skin friction, and airflow interference between aircraft components (such as would be found at the junction of the wings and fuselage, or fuselage and tail).

Phonetic alphabet A special way of saying letters and numbers that makes them less likely to be misunderstood over a radio.

A	ALPHA	N	NOVEMBER	1	WUN
B	BRAVO	O	OSCAR	2	TOO
C	CHARLIE	P	PAPA	3	TREE
D	DELTA	Q	QUEBEC	4	FOWER
E	ECHO	R	ROMEO	5	FIVE
F	FOXTROT	S	SIERRA	6	SIX
G	GOLF	T	TANGO	7	SEVEN
H	HOTEL	U	UNIFORM	8	EIGHT
I	INDIA	V	VICTOR	9	NINER
J	JULIETT	W	WHISKEY	0	ZEEROH
K	KILO	X	X-RAY		
L	LIMA	Y	YANKEE		
M	MIKE	Z	ZULU		

In addition, numbers are usually spoken as individual digits. For example, 123 would be read as "wun too tree."

Pilotage Flying cross-country, from one visible landmark to another, using only a flight chart.

Pitch The movement of an aircraft about its *lateral axis* (nose up or nose down). An aircraft is said to pitch forward when its nose points down and pitch backward when its nose points up.

Pitch/power rule The pitch/power rule states that for normal flight, unless the throttle is full open or full closed, power changes should be used to change airspeed, and pitch changes should be used to change altitude.

Pivot point The center of gravity on an aircraft.

Power glide A long, shallow approach in which engine power is used to maintain the glide. Power glides should be avoided when they are not required to maintain *instrument flight rule (IFR)* approach angles, because an engine failure can cause an aircraft to land short of the runway.

Primary flight instruments The six instruments displayed on the *standardized instrument cluster.*

R

Radials Directional beams that radiate from a *very high-frequency omnidirectional range (VOR)* station.

Radio stack The area where the *COM, NAV,* and *transponder* radios are displayed on an aircraft's instrument panel. They are usually stacked on top of each other.

Rate of climb The rate (measured in feet per minute) at which an aircraft is climbing. The term is also loosely stretched to include the rate of descent. The rate of climb is read on the *vertical speed indicator (VSI).* If an aircraft is at 1000 feet and is climbing at 500 feet per minute, then it will be at 1500 feet in one minute.

Rate of climb indicator See *vertical speed indicator (VSI).*

Rate of sink See *sink rate.*

Relative wind The wind moving in relation to the wing and aircraft.

Ridge lift When wind blows into the side of a ridge, it deflects upward and creates a region of lift that can sustain the flight of a sailplane.

Roll See *bank.*

Rotation Pulling back on the *control yoke* and raising the nose of an aircraft. Used during takeoff to lift the aircraft off the ground, and during landing to raise the aircraft's nose in preparation for the final *flare.* Also used to describe an aircraft's motion about its longitudinal axis during a spin.

Rotation speed The speed at which the pilot should pull back on the *control yoke* to begin *rotation* during takeoff.

Roundout See *flare.*

Rudder The control surface mounted on the trailing edge of the *vertical stabilizer* that controls *yaw.*

S

Sink rate Negative vertical velocity expressed in feet per second.

Skid When the rate of turn is too great for the angle of *bank,* and the ball at the bottom of the *turn coordinator* moves to the outside of the turn. To correct for a skid, increase the bank and/or decrease the rate of turn.

Slewing A method of changing aircraft position, direction, location, or altitude in Flight Simulator without flying. For more information, see "Slewing" on page 81.

Slip When the rate of turn is too slow for the angle of *bank,* and the ball at the bottom of the *turn coordinator* moves to the inside of the turn. To correct for a slip, decrease bank and/or increase the rate of turn.

Spoilers Vertical surfaces on an aircraft's wing that disrupt the flow of air over the wing surface, negating the wing's lift and slowing the aircraft down due to increased drag. Spoilers enable a jet aircraft to make a steep landing approach at a reduced speed. Also called terminal velocity dive brakes on the sailplane.

Spool up To bring a jet engine up to full power.

Stall The condition of an airplane or *airfoil* operating so that there is an airflow breakdown and a loss of *lift* with a tendency to drop.

Stall speed The speed at which an aircraft enters a stall.

Standard pressure 29.92 inches of mercury, or 1013 millibars. The pressure to which you calibrate your altimeter when flying at an altitude above 17,999 feet.

Standardized instrument cluster An industry-accepted de facto standard for the placement of the six most commonly used flight instruments. According to the standard, the top row includes (from left to right) the *airspeed indicator, attitude indicator,* and *altimeter;* and the bottom row includes (from left to right) the *turn coordinator, heading indicator,* and *vertical speed indicator.*

T

Tachometer The instrument that shows the speed of rotation of the engine. It is marked in revolutions per minute (rpm).

Takeoff roll To apply full power and increase aircraft acceleration to flying speed.

Taxi To move an aircraft on the ground.

Terminal velocity dive brakes See *spoilers.*

Thermal Air that rises due to the sun's heating of the earth's surface.

Throttle The control that determines the speed of the engine.

Thrust The forward force generated by the propeller or jet engine.

Traffic pattern The traffic flow that is prescribed for aircraft landing at and taking off from an airport. The usual components are the upwind, crosswind, downwind, and base legs, and the final approach.

Transponder An airborne radio beacon transceiver that receives interrogation signals from *air traffic control (ATC)* and selectively replies with a preset identification code, or "squawk code," set by the pilot. The squawk code is received by ATC and identifies the aircraft on ATC radar.

Trim The smaller control surfaces that affect the *elevator* in such a way as to make it less necessary to hold force continually on the *control yoke* in maintaining straight and level flight. Large aircraft also have *aileron* and *rudder* trim.

True airspeed The speed of an aircraft through the air after compensating for *density altitude*. Airspeed is determined by measuring the resistance as the aircraft moves through the air. At higher altitudes, decreased air density creates less resistance, and so a lower airspeed is recorded. True airspeed compensates for this.

Turn coordinator The instrument that displays the aircraft's turn rate and coordination.

Type certificate A rating based on aircraft strength and purpose that classifies an aircraft as Normal, Utility, or Aerobatic and, under FAR Part 23, limits the maneuvers the aircraft can legally perform.

U

Uncontrolled airspace The portion of *airspace* that has not been designated as Continental Control Area, Control Area, Control Zone, Terminal Control Area, or Transition Area.

Uncoordinated flight The mode of flight in which the pilot manually coordinates the *ailerons* and *rudder*. See also *auto coordination.*

V

Vertical axis An imaginary line running from top to bottom through the center of an aircraft.

Vertical speed indicator (VSI) The indicator that gives information on the rate of increase and decrease of an aircraft's altitude. Also known as the *rate of climb indicator (RCI)* or vertical velocity indicator (VVI).

Vertical stabilizer The surface of an aircraft that is used to help control motion about an aircraft's *longitudinal axis.*

Visual flight rules (VFR) The "rules of the road" that cover flight in those conditions wherein flight can be safely controlled by looking out the window.

Very high-frequency omnidirectional range (VOR) A ground-based radio transmitter that provides positive guidance on pilot-selected magnetic course radials or straight lines. A VOR transmits an omnidirectional synchronization signal followed by a circular sweeping directional signal. It is used in conjunction with the *NAV* radio and the VOR indicator.

W

Weathervane effect The tendency of an aircraft to pivot around its center of gravity until the *airfoils* are in back of the center of gravity with relation to the oncoming wind.

Winglets Vertical tips added to the ends of the main wings. They reduce drag and are a modern aircraft-design trend. The size of the winglets increases or decreases proportionally with the size of the main wings.

Wing loading An aircraft's weight divided by the square footage of its wings. For example, an aircraft weighing 4000 pounds that has 400 square feet of wing area has a wing loading of 10 pounds per square foot. The lower the wing loading, the less stress the wing surface is subject to during flight.

Wingtip vortex Wake turbulence trailing from an aircraft's wingtips.

Y

Yaw Rotation about an aircraft's *vertical axis.*

Yoke See *control yoke.*

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Support Services Worldwide

If you are outside the United States and have a question about Microsoft Flight Simulator, Microsoft offers a variety of no-charge and fee-based support options. To solve your question, you can:

- Consult the index in the product documentation and other printed product documentation.
- Check the README files that come with your product disks. These files provide general information that became available after the books in the product package were published.
- Consult electronic options such as CompuServe forums or bulletin board systems, if available.

If you cannot find a solution, you can receive information on how to obtain product support by contacting the Microsoft subsidiary office that serves your country.

Microsoft's support services are subject to Microsoft's prices, terms, and conditions in place in each country at the time the services are used.

Calling a Microsoft Subsidiary Office

When you call, you should be at your computer with Microsoft Flight Simulator running and the product documentation at hand. Have your file open and be prepared to give the following information:

- The version of Microsoft Flight Simulator you are using.
- The type of hardware you are using, including network hardware, if applicable.
- The operating system you are using.
- The exact wording of any messages that appeared on your screen.
- A description of what happened and what you were trying to do when the problem occurred.
- A description of how you tried to solve the problem.

Microsoft subsidiary offices and the countries they serve are listed below.

If there is no Microsoft office in your country, please contact the establishment from which you purchased your Microsoft product.

For this country	Use this number
Argentina	(54) (1) 814-5105
Australia	(61) (02) 870-2131
Austria	0222 0660-6738
Baltic states	see Germany
Belgium	(Dutch) 02-5133274 (English) 02-5023432 (French) 02-5132268
Bermuda	see Venezuela
Bolivia	see Argentina
Brazil	(55) (11) 533-2922
Canada	1 (416) 568-3503
Caribbean countries	see Venezuela
Central America	see Venezuela
Chile	56 2 218 5771
Colombia	(571) 618 2255
Denmark	(45) (44) 89 01 00
Dubai	(971) 4 513 888
Ecuador	see Venezuela
England	(44) (734) 271000
Finland	(358) (0) 525 501
France	(33) (1) 69-86-10-20
French Polynesia	see France
Germany	089 - 3176 - 1170
Greece	(30) (1) 6893 635
Hong Kong	(852) 804-4222
Ireland	see England
Israel	972-3-575-7034
Italy	(39) (2) 269121
Japan	(81) (3) 5454-8025
Korea	(82) (2) 563-9230
Liechtenstein	see Switzerland
Luxembourg	(Dutch) (31) 2503-77877 (English) (31) 2503-77853 (French) (32) 2-5132268
México	(52) (5) 325-0912
Netherlands	(Dutch) 02503-77877 (English) 02503-77853
New Zealand	64 (9) 357-5575
Northern Ireland	see England
Norway	(47) (2) 20 22 550
Papua New Guinea	see Australia
Paraguay	see Argentina
Peru	see Venezuela
Portugal	(351) 1 4412205
Puerto Rico	see Venezuela
Republic of China	(886) (2) 508-9501
Republic of Ireland	see England
Scotland	see England
South Africa	(27) 11 444 0520
Spain	(34) (1) 803-9960
Sweden	(46) (8) 752 68 50
Switzerland	(German) 01 - 342 - 0322 (French) 022 - 738 96 88
Uruguay	see Argentina
Venezuela	0058.2.914739
Wales	see England

Microsoft Flight Simulator Troubleshooting Guide for Setup

Memory requirements

To install and run Microsoft Flight Simulator, you need a computer with at least 1 megabyte (MB) of memory and at least 530 kilobytes (K) of free conventional memory available, with additional extended or expanded memory.

If your computer does not have sufficient free conventional memory or sufficient free disk space, the Setup program reports the problem and stops. Setup also informs you if your system is not configured for expanded memory. Before you can run Flight Simulator, you'll need to free up 530K of conventional memory by reconfiguring your computer.

Extended and expanded memory

Most of today's computers are configured with memory beyond 640K. This memory is referred to as extended memory. Flight Simulator uses extended memory for displaying graphics, but it performs faster if you configure extended memory as expanded memory. You can do this using the memory utilities provided with MS-DOS 5.0 and MS-DOS 6.0, or you can use third-party expanded-memory utilities.

To reconfigure your computer using MS-DOS version 6.0

MS-DOS version 6.0 is designed to help you configure your system for optimum performance. It comes with Memmaker, a utility designed to help you free up memory and configure your system for expanded memory.

1. At the MS-DOS prompt, type **memmaker**
2. Choose the Express Setup option and follow the instructions.
3. Make sure that you configure your computer to run with expanded memory.

After Memmaker configures your system, it reports the amount of free conventional memory. This is likely to be greater than 530K, which means your computer now has sufficient memory to run Flight Simulator.

To reconfigure your computer using MS-DOS version 5.0

With MS-DOS version 5.0, you can load MS-DOS into extended memory, and thereby free up additional conventional memory for Flight Simulator. MS-DOS version 5.0 comes with EMM386, a utility that configures your system for expanded memory.

1. At the MS-DOS prompt, type **edit c:\config.sys**
2. Add the following lines to the top of the CONFIG.SYS file (if necessary):

   DEVICE=C:\DOS\HIMEM.SYS

   DOS=HIGH

   DEVICE=C:\EMM386.EXE 2048
3. From the File menu, choose Save.
4. Restart your computer to make the changes take effect.

If you still don't have sufficient memory to run Flight Simulator, remove any terminate-and-stay resident (TSRs) and device utilities from your CONFIG.SYS or AUTOEXEC.BAT file. For more information, see the *Microsoft MS-DOS User's Guide.*

To reconfigure your computer using MS-DOS version 4.0 or earlier

In order to free up additional memory with MS-DOS version 4.0 or earlier, you can modify your CONFIG.SYS or AUTOEXEC.BAT files to remove TSRs and device utilities. See the *Microsoft MS-DOS User's Guide* before editing these files—improper modifications can cause problems.

Creating a System Startup Disk

If you are not able to free up sufficient memory or do not want to modify your CONFIG.SYS or AUTOEXEC.BAT files in order to run Flight Simulator, you can create a system startup disk (or boot disk) and use it to start your system when you run Flight Simulator.

1. Insert Microsoft Flight Simulator Disk 2 into your 3.5-inch disk drive.
2. Change to the drive where you inserted Disk 2.

   For example, if Disk 2 is in drive A, type **a:** and then press ENTER.
3. To run the FSSYSTEM program and create a system startup disk, type **fssystem** and then press ENTER.

   Follow the instructions, making sure you insert a blank disk into drive A before you format it.
4. When FSSYSTEM is complete, insert the new system startup disk into drive A and restart your computer.

   You will need to use this disk to start your computer every time you run Flight Simulator.
5. After your system starts, insert Microsoft Flight Simulator Disk 1 – Setup into your 3.5-inch disk drive and type **setup**

   Follow the instructions to install Flight Simulator.

Note If your system does not run properly, it may be configured to use devices required in your CONFIG.SYS file (for example, disk-doubling utilities such as Stacker®). If this is the case, you can create your own system startup disk following instructions in the *Microsoft MS-DOS User's Guide.*

Flight Simulator™ Quick Reference

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

These shortcut keys are for a standard keyboard with the function keys across the top. For information on other keyboards and key controls, see Appendix D, "Keyboard Summary."

Flying Controls

Airplane Controls

Autopilot on/off	Z
Brakes	PERIOD
Carb heat on/off	H
Coordinates on/off	SHIFT+Z
Differential brakes	F11 and F12
Jet engine shut down	CTRL+SHIFT+F1
Jet starter	J, PLUS SIGN (+) or MINUS SIGN (-)
Land Me	X
Landing gear up/down	G
Lights on/off	L
Magnetos	M, PLUS SIGN (+) or MINUS SIGN (-)
Parking brakes on	CTRL+PERIOD
Parking brakes off	PERIOD
Pause/resume flight	P
Smoke/spray on/off	I
Sound on/off	Q
Strobes on/off	O

Ailerons (bank)

Left	KEYPAD 4
Center	KEYPAD 5
Right	KEYPAD 6

Elevator (pitch)

Nose up	KEYPAD 2
Nose down	KEYPAD 8
Trim up	KEYPAD 1
Trim down	KEYPAD 7

Flying Controls, cont'd

Rudder (yaw)

Left	KEYPAD ZERO (0)
Center	KEYPAD 5
Right	KEYPAD ENTER

Throttle (power)

Cut	F1
Increase	F3 or KEYPAD 9
Decrease	F2 or KEYPAD 3
Full	F4

Flaps

Retract (0°)	F5
10°	F6
30°	F7
Extend (40°)	F8

Radio Selection

ADF	A, AA, AAA
COM	C or CC (fractional)
DME	F+1 or F+2—toggle NAV 1 or NAV 2 PLUS SIGN (+)—toggle distance from/speed toward station
NAV	N+1 or N+2, NN (fractional)
Transponder	T, TT, TTT, or TTTT
VOR/OBI	V+1 or V+2

Radio Frequency Setting

Increase	Select radio, PLUS SIGN (+)
Decrease	Select radio, MINUS SIGN (-)

Slewing Controls

Set aircraft position to North Heading, level pitch, level bank	SPACEBAR

Slewing Controls, cont'd

Turn Slewing On/Off — Y

Altitude

Up	Q
Up fast	F4
Freeze	F2 or F3
Down fast	F1
Down	A

Pitch

Nose up	9
Nose up fast	F5
Freeze	F6 or F7
Nose down fast	F8
Nose down	ZERO (0)

Bank

Left	KEYPAD 7
Right	KEYPAD 9
Freeze	KEYPAD 5

Heading

Left	KEYPAD 1
Right	KEYPAD 3
Freeze	KEYPAD 5

Movement

Forward	KEYPAD 8
Backward	KEYPAD 2
Left	KEYPAD 4
Right	KEYPAD 6
Freeze	KEYPAD 5

* 5 1 4 0 7 *

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